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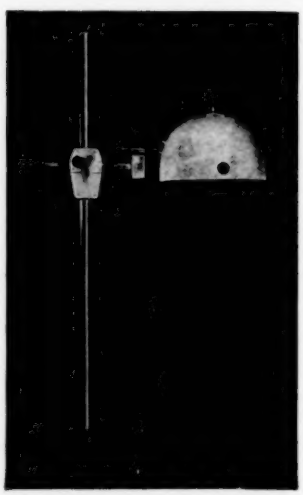

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MEDICAL VIEWPOINT OF INTERFERENCE WITH RADIO RECEPTION BY ELECTRO-MEDICAL EQUIPMENT *

In view of the legislation already enacted and that additionally proposed, empowering the Federal Communications Commission to issue regulations vitally affecting the many physicians and hospitals using electro-medical apparatus, also the manufacturers of such equipment, the following authoritative statements regarding the great value of short wave therapy are offered in the hope that they will prove of informative value to those responsible for or interested in such legislation.

The fact that there is still some interference in radio communication due to electro-medical equipment is not to be denied. Such interference of this type as is now experienced comes largely from the comparatively small number of spark-gap type diathermy machines that remain in the use of physicians and hospitals. However — IT IS IMPORTANT TO NOTE — this type of apparatus has been and is being largely superseded. The majority of practitioners who today use this character of equipment employ tube-operated short wave diathermy machines. It is obvious, therefore, that the interference, caused by the spark-gap diathermy, is not only on the decline but will soon cease to be a serious factor due to the obsolescence of this apparatus and the fact that the manufacture of spark-gap diathermy machines has been almost entirely discontinued.

A further important consideration is the fact that modern short wave diathermy apparatus are being designed with line filters which effect a still further reduction in radio interference, rendering it very likely that such apparatus will be far from the worst offender in the matter of interference to television and communication channels.

Little or nothing is said regarding the interference caused by the use of x-ray apparatus. Years ago, however, when transformers used to generate x-rays supplied a current which was rectified by mechanical means, more or less interference with radio communications was produced. During the last ten years, this method of rectifying current has been greatly improved, by the use of kenatrons, and thus the factor of interference has virtually disappeared.

The reduction of interference, of course, is desirable. Various interests are affected — communications being highly important. Medical interests are equally important as will be seen from the facts given below.

In various conferences and informal discussions that have been held between representatives of the Federal Communications Commission, Government Departments, particularly the Army and the Navy, radio and television interests, the American Medical Association, American Congress of Physical Therapy, American Hospital Association, American College of Surgeons and numerous other societies and groups of manufacturers of electro-medical equipment, many facts and issues vital to medical practice have been brought out. The more important of these follow:

* This meeting was suggested by Mr. E. K. Jett, Chief Engineer of the Federal Communications Commission, who selected Mr. Howard A. Carter, Secretary of the Council on Physical Therapy of the American Medical Association to cooperate with the Federal Communications Commission by calling this meeting, which was held in Harkness Hall, Columbia University, January 9, 1939.

THE MEDICAL ASPECTS OF THE PROBLEM OF RADIO INTERFERENCE *

FRANK H. KRUSEN, M.D.

Associate Professor of Physical Medicine, Mayo Foundation Graduate School University of Minnesota; Chief of Section on Physical Therapy, Mayo Clinic, Rochester; Member of Council on Physical Therapy American Medical Association; President, American Congress of Physical Therapy.

Rochester, Minnesota

I feel that I am voicing the opinion of all the physicians with whom I have talked when I state that it is our desire to coöperate to the utmost in any plan for preventing radio interference. Although it has twice been stated by Mr. Jett that he is fully familiar with the therapeutic value of electromedical apparatus, it is not apparent from subsequent remarks by this gentleman that the Federal Communications Commission really is familiar with the extreme value of these electromedical devices. If the physicians were certain that the members of the Commission and the various manufacturers of receiving devices are convinced of the value of this type of apparatus in medicine, there would be little need for my presence here. However, the members of my committee feel that the representatives of the Commission and the manufacturers of receiving devices are not fully cognizant of the extreme importance of medical and surgical diathermy in the preservation of life and health. It is a matter of understanding by everyone present at this conference of the relative importance of the use of electromedical apparatus for treating disease as compared with radio receivers for communication.

At the outset, my group desires to stress that we believe that any curtailment of the use of these high frequency electrical energies in the treatment of disease would cause great hardship to many sufferers and would even prevent the saving of many lives. We believe that high frequency electrical currents were used in medicine long before they were used in communication. In 1892, d'Arsonval used a high frequency coil for the treatment of disease, and in 1893 Rivière used high frequency sparks for the destruction of cancer. If priority is of any significance, the medical man has it.

Today the physician uses diathermy for almost innumerable purposes. It is used to produce controlled, deep, and homogeneous heating of local regions of the body which cannot be obtained with other thermal methods. It is used to produce most accurate elevations of general bodily temperature in order to combat a number of extremely serious systemic diseases. The physician uses diathermy in many ways: for surgical purposes, for desiccation, for coagulation and for cutting of tissues. The longer radio frequencies are most suitable for this purpose. The Council on Physical Therapy has suggested the utilization of local diathermy in contusions, muscle injuries and inflammations, sprains, dislocations, certain chronic inflammations of tissues, traumatic tenosynovitis, chronic arthritis, fibrositis, fractures, genito-urinary diseases, pelvic infections, respiratory diseases, pneumonia, gastro-intestinal diseases, nerve inflammations and infections.

Among the diseases in which general diathermy (fever therapy) may be used to great advantage are gonorrhea (particularly gonorrheal arthritis), syphilis (particularly syphilis of the nervous system) and chorea (St. Vitus dance), to mention but a few. In operations, diathermy has become indispensable to many surgeons in the removal of vascular (bloody) tumors, in bladder conditions, especially enlargements of the prostate gland, infected masses, masses containing toxic material and especially in the extirpation of cancer, to say nothing of the life-saving electrosurgical methods for the removal of brain tumors.

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* Spokesman for the Committee on Radio Interference of the American Congress of Physical Therapy, members of which include Dr. William Bierman, Assistant Clinical Professor, New York University College of Medicine; Dr. K. G. Hansson, Assistant in Surgery, Clinical Reconstruction Hospital, Surgeon-in-Chief, Physical Therapy Department, etc.; Dr. John S. Coulter, Associate Professor of Physical Therapy, Northwestern University Medical School, Member of the Council on Physical Therapy, American Medical Association, *Chairman of Committee*, Harkness Hall, Columbia University, January 9, 1939.

In the New York Hospital during 1938, 60,000 medical treatments were given in the Department of Physical Therapy, and the majority of these treatments included the use of diathermy. At the Mayo Clinic, six or more diathermy machines were in constant operation daily, and of more than 7,000 patients who passed through the Section on Physical Therapy in 1937, a large percentage received diathermy in some form. There are over 2,200 hospital physical therapy departments in the United States, practically all of which possess one or more diathermy machines, and it is estimated that there are at present no less than 30,000 to 40,000 short wave diathermy devices in the possession of physicians in this country and that between $15,000,000 and $25,000,000 are now invested in medical diathermy equipment alone. By conservative calculation it is evident that relief for pain and suffering and even the saving of lives affect no less than 300,000 patients daily or an average of ninety million treatments per year.

Some idea of the great interest in this field can be drawn from the consideration of the fact that an International Congress on Short Waves was held in Vienna in 1937, at which conference representatives of many nations discussed enthusiastically the medical uses of high frequency electric energy. Likewise, there was held in New York an International Congress on Fever Therapy to which thirteen foreign nations and our own Army, Navy, and Public Health Services sent official delegates. There was definite agreement at this meeting concerning the great value of high frequency electric energy in treating disease. It has been shown that proper use of medical diathermy might shorten the period of convalescence in certain diseases and injuries, thus lessening the cost of medical care and returning the patient to his occupation in shorter time.

Still more important, both in medicine and in surgery, diathermy may save lives. We medical consultants understand that in the field of communication matters of life and death take precedence over all others. Thus the S O S takes precedence over other communications. May we suggest that each interfering diathermy sound or television flicker may in reality be a life and death matter (a physician's joust with death), equally as important as the S O S. Are these lifesaving measures to be weighed in the balance with undeveloped forms of home amusement?

Mr. Jett has stated that the Federal Communications Commission is opposed to the assignment of any bands to physicians, yet the Communications Commission has already assigned two very broad bands to television, which is not even yet established on a commercial basis. Mr. Jett mentioned that services on these bands "are too important to be interfered with." What is more important than the life and health of the nation? Mr. Wilmotte stated during the morning session that interference with radio programs is "not particularly pleasant." I wish to emphasize that death is a tragedy and not an amusement. Mr. Hanson has mentioned that physicians might have an irate public complaining about diathermy interference with television. We feel that it would be better to have many irate persons than one dead person who might have been saved by the use of electromedical devices.

Doctor Wheeler has said that if the economic side of the question could be disregarded, then the problem of radio control of electromedical apparatus is comparatively easy. There is a very large "if" in his suggestion, since the economic problem cannot readily be disregarded. Interference could not be controlled by the methods suggested by Doctor Wheeler without greatly increasing expense and thus seriously curtailing medical use.

My group has been told that in certain countries in Europe the physician is given first consideration in matters of radio interference, and that he who complains of interference from electromedical apparatus pays the cost of controlling it.

It is difficult to present to you tangible evidence of the striking results which may be obtained with medical application of short radio energies. If you could only see a child with St. Vitus dance tossing about in his bed before the use of fever therapy and then see him calm and free from all jerking movements ten days later, you might appreciate the real situation. If you could but see, as physicians do, paretics (patients with syphilis of the nervous system), completely incompetent mentally, who are restored to useful citizenship, you might be more cognizant of the value of these procedures.

In electrosurgery, I can show certain tangible results. For this purpose I have brought with me a film on surgical diathermy in cancer of the face, which shows graphically just one of the many uses of diathermy in medicine. This demonstrates how a cancerous growth of the nose can be removed rapidly and safely with practically no bleeding by the use of surgical diathermy.

After seeing this film, you may understand why Dr. Howard Kelly (famed surgeon, one of the four great medical leaders who established the Johns Hopkins Medical School) said of surgical diathermy, "The dissection is far more beautiful and cleaner, more rapid and more satisfactory than knife work, especially in separating intra-abdominal adhesions. . . . While by no means altogether rejecting the scalpel, I give the acusector the leading place and decided preference in my daily work, relegating the scalpel to a subordinate position."

The consultants on medical diathermy feel that it is of the utmost importance that nothing be done to hamper such great surgeons in their lifesaving efforts. Dr. Harvey Cushing (famed Harvard brain surgeon) has said of surgical diathermy, "The results have exceeded all expectations and the methods of brain tumor extirpation have been . . . . largely revolutionized by these new principles." Cushing has also said, "By this new method we have at our command a device which makes it possible to extirpate tumors hitherto inaccessible . . . . it holds out untold possibilities for the future of neurosurgery."

Finally, we ask you to remember that in medicine, as well as in surgery, equally striking, but less readily demonstrable results may be obtained. There is no room to question the extreme need for keeping these medical and surgical services to the nation completely unimpaired. Of course, we physicians want to coöperate, but we feel that health comes first.

* * *

HOSPITAL VIEWPOINT FOR EQUITABLE REGULATIONS *

MALCOLM T. MacEACHERN, M.D.
Associate Director, American College of Surgeons,
President, International Hospital Association
Chicago

Members of the medical and hospital professions are completely in sympathy with the aims of the Federal Communications Commission to assure the minimum of interference with radio reception. They recognize that beyond the entertainment value of radio are values in education, national defense, and the prompt meeting of emergency situations. Often the doctor and the hospital share with their patients the benefits of radio. Obviously no opposing forces are aligned in this struggle to clear the air waves, for radio has been a most useful ally in advancing the theory and the practice of medicine. However, it would be unfortunate if in an attempt to ban radio interference, drastic measures were to be employed which would interfere with an object which has at least equal social justification — the extension of medical and hospital care, including the use of electro-medical equipment, to the greatest possible number of sick people at the lowest possible cost.

* Abstract of address, Harkness Hall, Columbia University, January 9, 1939.

The electrical devices in use in the modern hospital are the result of slow development and of laborious testing, and they represent in the aggregate a huge investment which is paying dividends in the relief of human suffering. It is manifestly unwise to restrict the benefits of these devices by requiring hospitals to undertake costly replacements and modifications which must inevitably raise the expense to the patient and thus inhibit their use. The shielded rooms which some radio engineers suggest would involve a high outlay which hospitals have no funds to meet and which would in no way help the patient. Restrictions upon current frequency introduce the probability of impairment of the value of treatment with certain devices. Screening and filtering seem also to involve interference with the efficiency of the equipment which offsets their value in reducing interference with radio reception.

The situation, therefore, is one which, at this stage of the development of both radio and electro-medical equipment, demands compromise. Hospitals and doctors should consider it an obligation to co-operate in reducing radio interference by inviting periodic inspection of their equipment by the specialized engineers whom most electric utility companies employ, by having any defects remedied, and by adopting gradually, as thoroughly tested equipment is developed, instruments and appliances which meet higher standards so far as non-interference with radio reception is concerned. The 2,664 hospitals which are approved by the American College of Surgeons can be relied upon to co-operate in any reasonable program aimed to correct this difficulty. The communications authorities should likewise consider the medical and hospital aspects, and permit the present large investment in equipment to yield reasonable returns in terms of use before it is declared obsolete for causes having nothing to do with its efficacy in maintenance of health and treatment of disease. Especially does this course seem indicated when the regulations which are under consideration might reduce the therapeutic value of the equipment. There is no gain to society in reduction of one kind of interference by imposition of a new kind, and the sick deserve the forebearance of the radio audience under a program whereby gradual progress may be assured.

* * *

COOPERATION IN THE USE OF RADIO CHANNELS *

A. U. DESJARDINS, M.D.

Director, Division of Radiology, The Mayo Clinic,
Member, Council on Physical Therapy, American Medical Association
Rochester, Minnesota

At one time some years ago, when transformers used to generate x-rays supplied a current which was "rectified by mechanical means," more or less radio interference was produced. During the last ten years, however, this method of rectifying current has been greatly improved by the use of kenatrons, and since that time the question of radio interference by x-ray apparatus has become less and less important. At the present time, the number of mechanically rectified generators still in operation is diminishing rapidly and those that remain are chiefly in the smaller cities and towns. A few of the old Snook transformers are still "snorting away," but these also are almost entirely limited to small communities and therefore cause comparatively insignificant trouble as far as radio interference is concerned.

The main source of radio interference produced by medical apparatus now seems to be largely confined to short wave diathermy machines, a considerable number of which is scattered in hospitals and in the offices of private physicians all over the country. Perhaps about $25,000,000 worth of such equipment is now

* Abstract of address, Harkness Hall, Columbia University, January 9, 1939.

in use by physicians. Even if it is assumed that 50 per cent of such equipment might be dispensed with without great or serious interference with the medical care of patients, there still remains 50 per cent of apparatus of this kind which is extremely important in the treatment of a great many patients. To arbitrarily force physicians to abandon the use of such equipment because it may interfere with radio communication or television would seem entirely unjustifiable, although some limitations as to hours of use might possibly be adopted. If this procedure should be followed by the Federal Communications Commission, the Commission should carefully inquire into the time of day most important from the standpoint of medical care. This probably would be found to be during the daytime when most hospital patients and when most patients coming to physicians' offices are treated. With the exception of a few large cities such as New York, Philadelphia, and Boston, very few patients would be treated during the evening, when radio interference would be most important. If private physicians, as well as large medical institutions such as hospitals, were forced to adopt either crystal control or shielding to eliminate interference, this would involve a considerable increase in the cost of the apparatus or in the cost of using the apparatus, and this cost of course would be passed on necessarily to the patient. This would mean an additional item to the cost of medical care which already is increasing rapidly enough. Frequently the medical profession is blamed for the increase in the cost of medical care. Certainly, it could not be blamed in this case when the profession is doing everything it can to prevent the adoption of arbitrary measures that would necessarily force the cost upward.

Recognizing the great importance of radio communications, especially by the Army and Navy and also for civilian purposes related to sickness, life and death, as well as for commercial transactions, there is no doubt that every possible measure that can help to diminish or eliminate interference with communications should be adopted, but it must be recognized that a considerable proportion of radio communications as well as television are merely matters of entertainment and, therefore, should have only a secondary value. It is almost inconceivable that the commercial firms who are interested in radio communications or television from the standpoint of entertainment should be allowed to monopolize the entire spectrum to the exclusion of hospitals, physicians and their patients.

* * *

THE INDUSTRIAL AND ECONOMIC ASPECTS *

A. W. MATHIS
Vice-President and Director of Sales, H. G. Fischer & Company
Chicago

The economic aspect from the viewpoint of doctors using short wave diathermy machines is a particularly serious one. Perhaps three-fourths of the thirty odd thousand short wave machines in use in the United States have been purchased by the doctors on the installment plan. These installments run over a period of from a few months up to, very generally, two years; in some instances even three years. This accommodation of being able to secure these machines on extended monthly payments is usually secured by the doctor at a cost of ½ of 1% of the deferred payment balance for each month the deferred payment contract runs. This very high premium paid by the doctor in order to be able to purchase the short wave diathermy machine, clearly indicates the substantial sacrifice to him that the purchase of the short wave diathermy machine is, and that this outlay on his part is very much of an effort and a serious matter. When this substantial sacrifice has been made on the part of so many doctors,

* Spokesman for manufacturers of medical short wave equipment; abstract of address, Harkness Hall, Columbia University, January 9, 1939.

it seems that it would be a great hardship on the doctor for some regulation or law to be passed that would prevent him from using the machine for the purpose for which it was purchased over a period of time at least adequate for him to liquidate his investment.

Prominent physicians studying this problem have estimated that a doctor who purchased one of these machines should be allowed eight years in which to liquidate his investment without its becoming an undue hardship upon him. This is not far out of line of the reported five years that were given to users of spark gap radio equipment in which to liquidate their investment, when regulations were passed causing the discontinuance of use of spark gap radio equipment at a future date. Taking in view the fact that the doctors use these short wave diathermy machines for the relief of human suffering and that a goodly portion of their use is on patients from whom no fees are collectible, it appears that they are entitled to reasonable and preferred consideration.

The manufacturers of short wave diathermy apparatus are confronted with the fact that they have sold a great number of these short wave diathermy machines on the installment plan and in the majority of instances have hypothecated this installment paper in order to secure funds to pay wages and otherwise to carry on their business. Were some law or regulation passed that would prevent the doctor-purchasers from liquidating their investment in an orderly and reasonable way, it would mean that a high percentage of these machines whereon there was an unpaid deferred payment balance would be returned to the manufacturer because the doctors would become unwilling and unable to continue their payments on the machines on account of being unable longer to use them. The manufacturer would no longer have a market for these machines and consequently they would have little if any value when repossessed or returned to the manufacturers. The installment paper that had been hypothecated by the manufacturers due to the inevitable delinquencies arising through loss of the use of the machine would have to be repurchased by the manufacturer in that it is all sold with full recourse. This contingency would undoubtedly bankrupt a goodly number of the manufacturers, work tremendous hardship on all of them, and cause thousands of people who derive their livelihood directly and indirectly from this industry to have their interests greatly prejudiced.

The manufacturers and others engaged in the sale of short wave machines unavoidably have large numbers of these machines in stock, in showrooms, potential customers' offices, warehouses and factories, plus the accumulation of raw, partially completed stock and other inventory incident to and necessary to carrying on this substantial-sized business. In order to avoid undue hardship, perhaps even financial disaster, to those engaged in the manufacture or sale of short wave diathermy equipment, it would be necessary, in the opinion of a group representing most of the manufacturers in the industry, that about two years be allowed the manufacturers in which to liquidate their holdings. It would be highly desirable and, in order to avoid excessive hardships, necessary that were such laws or regulations enacted forcing expensive adequate screening or expensive crystal control of short wave diathermy machines, that before such regulations should take effect the manufacturers be given two years in which to liquidate their investments and that the doctors who purchased this equipment before that two years shall have expired shall be given eight years in which to liquidate their investment. This is particularly true because of the fact that so-called adequate screening or satisfactory crystal control will increase the initial expense the doctors are put to to purchase these machines probably 50%. and, secondly, because to make such alterations is neither practical nor in many instances possible on the machines now outstanding.

The doctors and the manufacturers supplying their needs were in this field first, contribute greatly towards the maintenance and the return to health of

hundreds of thousands of our citizens, and prolong life. If some other interest must interfere with the orderly liquidation of the investment of the doctors who have purchased this equipment and the manufacturers in the industry, then it does appear that the burden of the expense of making such changes as inflict onerous hardships on those who have built and purchased these machines in good faith should be borne by those desiring the elimination of this interference.

At the meeting held on January 9, 1939 in Harkness Academic Theater, Columbia University, New York, at which the interference of short wave diathermy machine with television receiving was demonstrated, it is worthy of note that the machine was not used as it is used in a doctor's office and on an actual patient, but rather it was so arranged and set up as to cause it to generate interference rather than any effort to determine how much interference it caused to the television receiving set when used under actual conditions similar to those employed in a doctor's office or in a hospital. *It has subsequently been reported that the machine used to demonstrate the interference with the receipt of television at this conference was altered or changed somewhat in order to cause it to make the interference more pronounced. This change or alteration was not announced to the conference by the engineers demonstrating the extent of the interference. This was all the more interesting in view of the fact that during the conference and during the demonstration of the interference with television receiving, it was claimed by representatives of manufacturers who were in position to have knowledge that there were probably one hundred short wave diathermy machines within a radius of a few miles of this demonstration and that these machines were normally intermittently used at that time of day and they evidenced no interference with the television receiving set being demonstrated at the conference.*

Other forms of interference with radio communication were reported and described at the conference. Even phonograph records were introduced, with the claim that they were a record of the interference caused by a short wave diathermy machine. This claim, if considered in the light of the method that was employed in exhibiting the interference of the short wave diathermy machine with the receipt of television, could hardly be accorded much weight.

Several engineers have pointed out the fact that short wave diathermy machines are by no means the only source of interference with television and other radio communications, and that this source could not be termed the most objectionable. The list of items it is claimed offer substantial interference includes, among others, the following:

All electrical equipment wherein an electric arc is formed: (1) Bombarders, (2) Vibrators, (3) Motors, (4) Converters, (5) Street Lighting System, (6) Street Cars and Elevated System, (7) Neon Sign Flashes, (8) Elevators, and others.

* * *

EDITORIAL COMMENT

To summarize all that has been stated by those men imbued with the highest ideals as citizens and as men interested in the welfare of our great nation one would have to formulate the essential thought that we are concerned with a public utility vitally affecting the very health of our nation and the resulting saving in national man-power. In addition this public utility concerns also certain commercial interests whose profits are derived from a service to the people the value of which is by no means under-rated but nevertheless of incomparably lesser importance from the standpoint of the common weal. That a compromise is possible by measures both equitable and effective

does not appear to be beyond the possibility of realization. It all amounts to a matter of good will toward the concerned parties with a view of arriving at a solution of the problem that will satisfy all the people of the United States. Nor is it to be ignored that the problem cannot be concentrated on the medical profession alone since it is established that many factors in the life of the nation most of them to be classified as daily necessities also affect the industries of radio transmission and television. Our greatest problem today is not pleasure nor conveniences but national defense and it seems that it must be clear to any unprejudiced mind that the preservation of national health is of greater importance in the achievement of national security than the transmission of an image on a screen. While we are all aware of the radio in the domain of modern strategy, it would take a wide stretch of imagination to conclude that the treatment of the injured soldiers in war hospitals by short wave diathermy would in any way interfere with the transmission of military orders to the troops in the field. Accordingly the problem should and can be solved only by the old American principle of give and take or live and let others live. It stands to reason that the health of a nation is the wealth of a nation. — *Editor.*

THE PRESENT STATUS OF THE HEARING AID PROBLEM *

HORACE NEWHART, M.D.

MINNEAPOLIS

Notable improvements in the construction, performance, distribution and servicing of electrical hearing aids have been made so rapidly during the past five years that this subject has become one of compelling interest to the otolaryngologist. Hearing devices embodying new features and principles have been announced at such frequent intervals by the manufacturers that the genius of their engineers has been constantly challenged to produce better aids than their competitors. As a result, the otologist has often been at a loss to evaluate the new devices released by different makers and the consumer has been confused and bewildered.

To present adequately the present status of the hearing aid problem with its many angles is impossible within the limits of an article. It is only possible briefly to point out some of the important improvements recently achieved and to consider certain facts related to a better understanding and cooperation among the manufacturers, otologists and the aurally, and often financially, handicapped consumers.

Of the 50,000 or more electrical hearing aids sold in the United States in 1937, at least 95 per cent were of the carbon microphone type. Until five years ago improvement in their construction and effectiveness was slow. They occupied practically the entire field. The advantages of this type were their wearability and low cost. The disadvantages of the carbon microphone type have been the limited range of response in the reproduction of speech sounds; poor fidelity; marked distortion with increased amplification; abrupt peaking of the response curve in narrow bands, especially in the higher frequencies; a pickup limited to relatively short distances; early deterioration of

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the carbon particles with use, causing decreased output; internal noises produced by movement of the carbon element and a cutting off of the output with the microphone held in any position other than the upright.

Improvements in this type of hearing device include:

1. The introduction of the amplifying microphone or "booster" whereby the intensity is greatly increased. A very recent improvement in this component of a hearing aid is a modified construction which makes its output independent of its position, and the provision of a built-in switch for instantaneously cutting the amplifier out of the circuit when it is not needed.
2. The development of the bone conduction receiver or oscillator which greatly increases the effectiveness of hearing aids for persons whose loss is predominantly of the conductive type.
3. Improved dry cells of longer life and various sizes, of 1½, 3, 4½ and 6 volts; rechargeable storage batteries and the means of depolarizing or rejuvenating dry cells, all of which have lessened the operating cost.
4. Reduction in the size and visibility of the midget receiver which has been made more powerful and is provided with individually molded ear tips which provide better contact between the receiver and the ear and give increased comfort to the wearer. The midget receiver requires no headband.
5. Refinement and greater stability of the carbon elements, lessening the internal noises and the tendency to deterioration with use.
6. A wider response curve, extending in some instruments to 4,000 cycles.
7. One maker has introduced a new principle, utilizing two batteries with separate circuits, one for the microphone and one for the amplifier, resulting in improved reproduction.
8. The most outstanding improvement in carbon microphone hearing devices which within the past two years has been adopted by at least four of the best known manufacturers has been the procedure of "selective amplification" which makes possible their more accurate fitting. By this means selection is made from several of the available component parts of the hearing device,—the microphone or transmitter, the amplifier, the receiver and battery, each capable of definitely modifying the degree of amplification at different frequencies, thus producing the response curve which will most nearly meet the user's need in the assembled instrument, as indicated by his audiogram.

Master Hearing Aid

By a master hearing aid, designated by different manufacturers by a distinguishing trade name, as aurogauge, audioscope, analyzer, audioselector, selexophone, and others, the various component parts are each in turn placed in the circuit and tried out by speech articulation tests, until that combination is found which gives the best hearing. This frequently is not the combination which is the most pleasing to the wearer. He often prefers one whose response curve corresponds somewhat more nearly to his deficiencies instead of compensating for them. Thus a period of adjustment is necessary before he becomes reconciled to the changed sounds he hears. This fact is one of the strong arguments of the distributor against allowing the purchaser a trial period, a privilege greatly desired by the consumer. In granting this request the representative fears the purchaser often will not persist long enough to appreciate the real superiority of the indicated hearing aid and will discredit the instrument, the distributor and the otologist who recommended the device.

The extent to which hearing aids can be prescribed by the otologist from an audiogram with the same accuracy with which the ophthalmologist

prescribes glasses, has not yet been fully determined. It is an ideal which all would like to see realized.

Hayden as a result of extensive investigation has enthusiastically pointed out some of the possibilities in this field. He used special audiograms which plot the hearing loss by air and bone conduction at octave letter steps and compared them with performance curves of typical assembled aids with very successful results. The criticism has been suggested that this procedure, employing octave letter steps, is too time-consuming, also that certain variables are involved which make questionable the need of employing such small frequency intervals in attempting to assemble a hearing aid whose response curve must match closely the peaks and valleys of an audiogram of this kind. These variables include (1) the inconstancy of the performance of carbon hearing aids in general; (2) the variations in hearing acuity to which every person, including the hard of hearing, is subject, and (3) the recently announced findings described by Fowler, Steinberg and other investigators, that in the higher frequencies the hearing is more acute for sounds of increased loudness. This is known as the "recruitment phenomenon." It has been found that when different bands in the speech range as broad as fifty cycles are filtered out, as has been done to reserve such frequencies for the exclusive use of airplane communication signals, there is no noticeable interference with the interpretation of speech by normal ears. These observed facts suggest that ears with impairment in certain areas of the speech range may be able to compensate physiologically for gaps of moderate length. It is to be noted that better results in many cases of perception deficiencies are obtained with vacuum tube amplifiers with their relatively flat response curve than with carbon microphone aids fitted by selective amplification.

Another outstanding step in the development of better hearing devices has been the production of individual aids employing vacuum tube amplification with crystal microphones. These instruments are superior to the carbon microphone type in that they have a greater intensity range, are more sensitive, cover a frequency range from 100 to 7,000 cycles, are free from abrupt peaks and distortion and possess greater fidelity in the reproduction of speech and music. Because of their large electrical consumption, until very recently they have been available only in the stationary and semi-portable forms.

During the past year at least two manufacturers have released aids of this type so reduced in size and weight, chiefly by employing very small vacuum tubes, that they are truly wearable. Other makers have announced that they will soon bring out similar models. One manufacturer specializes in making devices of this type only to order. Another incorporates in his wearable vacuum tube aid tone control as well as volume control, and has made available a special induction device for amplifying telephone conversation; also an attachment by which the electric house current may be used to reduce battery cost. Although the battery consumption of these aids is greater than that of carbon microphone devices, it is predicted that this disadvantage will be overcome soon by resort to small storage batteries.

Selection of Hearing Aids

An important responsibility of the physician is to prescribe for his hard of hearing patient the type of aid which will most effectively compensate for his deficiency. At least he should be able and willing to render him valuable help in the selection of such an instrument. Before he can satisfactorily do so he should familiarize himself with the elementary principles of physics

as related to sound and hearing, which is not a difficult problem. The larger manufacturers of hearing devices, keenly appreciating this need, are generously supplying the physician with informative literature of a high class quite as much for educational as for advertising purposes.

An audiogram made by means of a reliable audiometer equipped to determine hearing loss by both air and bone conduction and providing a means for masking is very important as the first step in prescribing or fitting a hearing aid. This enables one most easily and accurately to determine the amount of hearing loss at frequencies within the speech range at octave intervals or less, and to ascertain whether there is a preponderance of conductive or perceptive loss. According to the form of the graph and the degree of loss at different frequencies one ascertains if the patient can be served by a carbon aid or requires the greater amplification and elimination of peaks and background noises afforded by a vacuum tube instrument. In cases of extreme difference between the loss for low and high tones, especially the latter, with irregular peaking, selective amplification in either a carbon or vacuum tube aid is definitely indicated.

Thus we are able to decide from the audiogram if the individual will be adequately served by the simpler and less expensive carbon type with moderate amplification; requires a more powerful, especially assembled carbon aid with amplifying microphone; or, in order to hear satisfactorily even the consonant sounds of speech, needs the still more powerful vacuum tube device.

The physician who does not possess an audiometer, at a sacrifice of time and accuracy must make a careful functional test by tuning forks to gain as much of this needed information as is possible.

With the knowledge thus obtained one can tell the patient what type of aid he needs and, with considerable assurance, recommend that he try out the devices sold by the reliable representatives of several hearing aid manufacturers whose products have been accepted by the Council on Physical Therapy of the American Medical Association. The Council, with the cooperation of its Committee of Consulting Otologists on Audiometers and Hearing Aids, of which Dr. Hayden is chairman, during the past two years has rendered a very useful service by stimulating the raising of the standards of performance of hearing aids, and placing on a higher ethical plane the advertising, distribution and servicing of these devices. The larger manufacturers have generously cooperated in this effort. It remains for other less known manufacturers to submit their products to the Council for acceptance to obtain the same privileges, and thus protect the public and themselves from the acts of unscrupulous distributors whose inferior wares and unfair practices bar them from recognition by the Council.

The patient should become acquainted with the products of more than one maker for his protection and that of the otolaryngologist, since improvements are made at a rapid rate and the models of different manufacturers have outstandingly different individual features which may become outmoded in a short time. The purchaser will be better satisfied and less likely to blame us if he is given the opportunity to choose, even if the compared aids are equally satisfactory in performance. When there is doubt, resort should be had to the articulation or intelligibility test by which the performance of a given aid is compared with that of another by having the subject prove his ability to hear correctly syllables or words which have similar sounds. Several well known lists for this purpose are available, one of the simplest being that of Dr. Robert West, Professor of Speech Pathology at the University of Wisconsin. Such tests must be made under identical conditions and the person who reads the words should have no financial interest in the sale of an instrument.

In the selection of hearing aids the following considerations are to be noted:

1. The requirements of many persons with a moderate conductive loss with a nearly horizontal graph are easily met by a low cost instrument of moderate amplification which will serve him well unless he is keenly discriminating as to quality of reproduction.

2. Air conduction receivers should be given to persons who have primarily a perceptive deficiency, and bone conduction aids to those whose loss is chiefly of the conductive type. Many persons with a severe hearing loss have both a conductive and perceptive impairment. A vacuum tube instrument with air conduction receiver often gives equally satisfying or better results in such cases than a carbon aid with a bone conduction receiver. There apparently is a growing tendency to prefer air conduction to bone conduction for patients having this type of deficiency.

3. For persons with a pure or predominantly conductive loss, an amplification equal to the hearing loss in decibels minus 20 decibels is usually adequate to give excellent hearing with a minimum of discomfort from extraneous or "background" noises. These have been so disturbing to persons with a loss of less than 35 to 40 d.b. using ordinary carbon aids that they have preferred to use their unaided ears to enduring the discomfort of amplification with the best instruments formerly available. Thus a larger number of persons than formerly can be benefited by the use of modern, high quality aids. Fewer need go through life under the constant nervous strain caused by even a moderate hearing handicap.

It should also be noted that individual hearing aids have a wide field of application, as yet largely unrecognized, among young children with a seriously handicapping hearing loss which prevents the normal acquisition of speech in the home and school. Many children of this type are found in schools for the deaf who are there because of speech defects which the early use of a modern hearing aid would have obviated.

The cost of hearing devices is a serious problem to many persons. While the difference between the manufacturing cost and selling price seems unjustifiably large we should recognize the heavy expense necessary to maintain research, a costly national educational campaign advertising the possibilities for better hearing by means of modern electrical aids, and the great expense incident to the distribution and servicing of products of this kind. It is hoped that ultimately through standardization, quantity production and fair competition the cost will be materially reduced.

As of special interest to the otolaryngologist at this time I quote from the concluding paragraph of the excellent article by Drs. Jones and Knudsen on "What Audiometry Can Now Mean In Routine Practice" in the American Medical Association Journal of August 13, 1938, these significant words: "As the science and art of audiometry progress, more specific criteria and procedures than those here presented will become established; but even now the otolaryngologist can and should take over the use of audiometry in serving his hard of hearing patients. If he does not, others will."

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Discussion

Dr. Austin A. Hayden (Chicago): One of the newest things in hearing aids is the presentation of this sort of paper to this sort of group, because up until now not even otologists in sufficiently large numbers have been interested in this all important subject.

Up to the year 1872 only mechanical hearing aids were available. These consisted of tubes, fans, trumpets and horns of many kinds and varieties. The oldest and most universally used non-electrical device is, of course, the human hand which when held up to the ear really increases the amplification of sound anywhere from 5 to 8 decibels, according to Dr. Sabine of Riverbank Acoustic Laboratories.

The original electric hearing aid consisted of a single transmitter, a receiver and a battery. Up to the year 1922 when Lieber introduced the fitted, molded ear tip — no doubt as a refinement of the stethoscope type — hearing aids consisted of the simple components just mentioned. The Acousticon was the pioneer instrument manufactured commercially and put on the market about 1899. It was one of these that was sent to England with great acclaim for use by one of the royal family.

Today in place of the single hearing device of Bell, the original, we have a large number of component parts from which to build hundreds of devices. Multiple transmitters, receivers and amplifiers about which Dr. Newhart spoke make this possible. There is the bone oscillator which Hugo Lieber brought out about five years ago, and there are numerous receivers of high, middle, low and broad pitch, including the old circular type of receiver that is still in use in many sets as Dr. Newhart has intimated, and instead of a single battery there are three batteries of very much better construction, longer life and cheaper cost. The battery cost is still a very considerable item, running perhaps from $20.00 to $50.00 a year.

It is said that this electrical power that drives these hearing devices is the most expensive sort of electrical current in commercial use. An effort has been made to get away from the high cost by the designing of a small storage battery and charger. The cost of the complete outfit is about $30.00. The possible saving is as much as 50 per cent, but less than 10 per cent of the instrument users use the device.

You can readily imagine that with this large number of hearing aid components, just as the oculist has a tremendous number of lenses in his trial case that may be used in any case of refraction and about two-thirds of them can be used in ninety different positions in correctly fitting a pair of glasses, the number of different components or combinations that can enter into a hearing aid is very conservatively estimated, as you can realize by the multiplication of the component parts that I have just mentioned, to be about 500. Now to get around that, Radioear of Pittsburgh, Mr. Myer's company, devised the first trial frame for hearing aids; that is to say, a patient can actually try the different combinations that the manufacturer has available in a machine that essentially consists of all the component parts rigged up so that by the pressing of buttons and the adjusting of wires and the interposition of the different parts into the machine, the patient can actually hear through the machine that he is going to buy and wear. That is a master hearing aid. The Selectaphone was the pioneer in this work. There are several of these, as Dr. Newhart has said, including the Sonotone and the Acousticon's so-called oral gauge.

An ingenious device has been manufactured. It is an oscillograph, and while the intelligibility tests that Dr. Newhart referred to are being tried on the patient, either sentences or words or letters or numbers, the loudness of the voice which the tester is using in the test can be gauged by the patient by looking at this little line of flickering light in this instrument, which is an accessory to the Acousticon's oral gauge, and it is also said to distract the patient's attention from any endeavor to read the tester's lips, and is quite an ingenious gadget added to the fitting armamentarium of this hearing aid company.

Dr. Newhart has mentioned audiometers, and he has very graciously mentioned the efforts of the Council on Physical Therapy of the American Medical Association to standardize audiometers and also their efforts to standardize hearing aids. It is perfectly evident, it seems to me, that not only the doctor but the indi-

vidual who purchases a hearing aid should know that it is more than just a simple box that he is buying.

Several audiometers are now on the market, including that of the Western Electric Company. Let me say that an audiometer is a radio tube instrument that produces tones as nearly pure as possible at certain frequencies, at certain designated intensities, for hearing no longer can be measured by a watch or by a tuning fork, or in any way except in terms of intensities and frequencies. The Western Electric hearing aid is equipped with a master, with a signal button, with a receiver, with dials to indicate the intensity and frequency of the tones that are to be tested, all the way from 128 to 8192 double vibrations to the second for air, and from 256 to 8192 for bone.

The Sonotone Knudsen audiometer accomplishes about the same purpose. Both the Sonotone and the Western Electric have a continuous frequency. By continuous frequency I mean that the pitches are not seven in number from 128 to 8192, but there are an infinite number of them. It is continuous from the very lowest tone up to the very highest tone that the instrument is capable of producing, but, unfortunately, the instrument does not begin that continuous frequency until the frequency range of 4000 or thereabouts, above the conversational range, the conversational range being from somewhere between 1000, as Dr. Newhart has indicated, and 3500. Ninety-five per cent of the tones of ordinary conversation will fall within that range.

The Maico Company audiometer, manufactured in Dr. Newhart's own city of Minneapolis, is a step-frequency audiometer pure and simple; that is to say, it has tones at octave frequencies and octave frequencies only with divisions into half octaves in the conversational range.

On one side of the Otologist Service audiometer is intensity and on the other side is frequency, that is, loudness and pitch, with a continuous frequency rate, just the same as the Western Electric has, but there is a difference in the dials. The Otologist Service audiometer has a large dial, while the Western Electric has a small dial. The Western Electric, consequently, has the continuous frequency range, but has not sufficiently large calibrations for that continuous frequency range to be used at octave letter frequencies.

The comparative results of these instruments for measuring hearing are something like this: To be absolutely satisfactory all of the lines on a chart should be together all the way across, but a composite audiogram of twenty-six patients, measured on all of the machines that I have mentioned with the exception of the Sonotone Knudsen, shows a variation. There is a variation in some spots of as much as 15 decibels, and the largest variation occurred at 1020, but at many spots along the audiogram the machines are almost together.

It is perfectly possible, inasmuch as these machines are only a few years old (they are a new diagnostic effort to improve the older methods of testing hearing), that we are expecting too much of these machines. I mean to say in the matter of absolute consistency. In general terms it is quite easy to build a machine that is absolutely accurate, if it is built for octave frequencies only or half octave frequencies, but if a continuous frequency sweep is to be expected, there are mechanical difficulties that are very hard to overcome.

As Dr. Newhart has indicated, finer examination of hearing will be by some sort of a machine that has a continuous frequency and that is especially true for the conversational range, above 1000 and below 4000. From 4000 to 800, from 4000 to 16,000 or 20,000, whatever the upper range of hearing is, and from 500 or 1000 down to 32 cycles per second, or somewhere around there, does not make so very much difference as far as conversation is concerned most likely, but the hearing range for conversation, the thing that the human ear is particularly developed for, is the important spot, and the selective amplification that Dr. Newhart has spoken of must be peaked, that is, the full force of the amplification or magnification of sound, with a little less variation and a little more consistency. The magnification of sound should be peaked at the exact point, as nearly as possible, as the defect in hearing exists, not a straight line all the way across but a peaking at the place where the hearing is defective.

The Otologist Service has devised an audiometer, and it has measured for the Sonotone Hearing Aid Company, and is perfectly willing to measure for other hearing aid companies, the responsible curves of the hearing aids themselves to show whether or not they peak their output of sound amplification at the place that is labeled or the specifications of the instruments say they do.

If a hearing aid improves the hearing, it ought to be possible with an audiometer to measure the improvement that it gives the patient when he is wearing that instrument. In a pretty fair bone case, the bone conduction was down to anywhere from 35 to 20 decibles in each ear and the air conduction much lower. With the hearing aid and the audiometer transmitter — I mean the earpiece of the audiometer placed on the transmitter of the patient's hearing aid, his hearing was improved up to 2048, from 128 to 2048, in his left ear, the ear with better bone conduction. As a matter of fact, the ear with the best bone conduction is generally selected for the fitting of hearing aids unless that ear happens to be the one that hears best by air. If it is the one that hears best by air, it is the rule to leave that ear open for reception of sounds by air and to fit the other ear.

In a case of mixed deafness the fitting is not likely to be so good. In a patient the ability to hear at four feet was increased to one at twenty feet, which was

not so favorable a case in general terms. In a study of about one thousand audiograms when the bone conduction line is high the fitting is most likely to be very satisfactory no matter how low is the air conduction line. That means that when there is good nerve function you can get a good result; when there is poor nerve function you get a poor result. The air may be down all the way to 80, and if the bone is 30 or 40 or even 20, you get a fine result with a hearing aid.

It has often been said that inflation of the eustachian tubes does not improve hearing, but we should like to refute that statement, for we can show an improvement of about 30 decibles almost all the way through.

An individual who had a skull fracture in January, 1937, said that he had noticed nothing wrong with his hearing up to that time. After that he had tetanus and also a marked reduction of hearing. His first audiogram was made in 1937, and in 1938, when he was about ready to have the instrument tried, his air conduction in the right ear had fallen.

The audiometer is of great importance in studies for medical or legal purposes or ordinary clinical purposes, of defects of hearing, and in the fitting of hearing aids it is of tremendous importance that audiograms be made by doctors and not by technicians. I noticed in a public plea by this organization that technicians should not supplant doctors in the various diagnostic and therapeutic procedures of physical therapy, and I take it that this procedure is a part of physical therapy in which technicians should also not supplant physicians. Audiometry should be in the hands of physicians, preferably in the hands of otologists. They are authorized by law, they are trained by experience and education, and I respectfully submit to this gathering an appeal to interest yourselves in these procedures.

Dr. Frank J. Novak (Chicago): I consider it a privilege to be permitted to discuss any paper that Dr. Newhart has written. He stands preeminent in the field that concerns itself with the problem of the hard of hearing. It is exceedingly difficult to follow Dr. Hayden in any discussion of this type. After he has taken the subject apart and put it together again there is very little, if anything, to say about it.

I shall devote the few minutes at my disposal to a reemphasis of one or perhaps two points that have been made. There was a time when a man with eye trouble wandered into a general store, looked over some specs, picked out a pair that seemed to suit his fancy and continued to wear them. That is a rather primitive and unsatisfactory sort of procedure and it seems rather absurd to us at the present time, and yet in the matter of choosing or of finding hearing aids for deafened patients that is largely the procedure that is current at the present time. The patient is told to find some aid that will help his hearing and he wanders into some store and buys a gadget that may help him and again may not.

The last point which Dr. Hayden made I think is of exceedingly practical importance. It won't be long before a group of individuals inadequately trained, perhaps not very intelligent, will call themselves "audiometrists," and will go into the business of prescribing hearing aids for patients who should be treated and managed and handled by the otologist. It is really up to the physician to see that this situation does not arise. The doctor is fundamentally trained as a biologist, his interest is in the biological sciences, and it would seem from much that we have seen here this morning that in addition to his training as a biological scientist he must become in a measure somewhat of an electrical engineer and perhaps an electrician or a radio engineer and a telephone repair man. Well, if that is necessary, it is necessary, and so without taking up any more time I will conclude merely by saying that the otologist must pay considerable attention to these rapidly-developing changes in the manufacturers' products of hearing aids.

Mr. Howard A. Carter (Chicago): I wish to reiterate the last point made by the two discussers. If the otologists do not fit hearing aids, technicians are going to do it. I cannot impress that point too strongly. In fact, fitters of hearing aids are being trained to do the work at the present time, a service which should be in the hands of physicians and more specifically, otologists.

Dr. Horace Newhart (closing): I would emphasize the great importance of informing the public as well as the medical profession of the injustice and harm to our hard of hearing people through the racketeer in hearing aids. He is known to carry on over wide areas through the country. He procures by any means he can, worthless, obsolete and discarded aids and sells them by high pressure sales methods to the uninformed and unsuspecting people in their homes at whatever exhorbitant price he can get, collecting the cash and disappearing overnight. This type of offender is liable to prosecution in every state, but is very clever and is rarely apprehended. The best way that we can combat this evil is to warn our hard of hearing friends of the possibilities of being swindled in this way and urge them to seek the advice of an informed physician before purchasing an electrical hearing aid, and, on his recommendation, deal only with reputable distributors.

RECENT TRENDS CONCERNING IMPORTANCE OF THE AUDIOMETER IN OTOLOGY *

G. HENRY MUNDT, M.D.

CHICAGO

Since the development of subjective methods of testing hearing, otology has made considerable advance in the diagnosis and management of deafness. The development of tuning fork tests for hearing defects was a very great advance in otology, and the improvements in tuning fork construction, which were particularly exemplified by Edelmann, caused a very general acceptance of a few tuning form tests which have well stood the test of time.

During the last two and a half or three decades a group of men became intensely interested in tuning forks and their application to otologic diagnosis. Some individuals in this group took it as evidence of disloyalty or lack of confidence when another method of subjective testing of hearing was first advocated. As a result, some very competent otologists felt that the advocacy of the audiometer was a challenge to the efficacy of the tuning fork tests.

Within the last few years I have seen very definite evidence of the acceptance of the audiometer as simply another method of auditory examination, and I think that there is now no feeling that the audiometer is an interloper or that its advocacy in any way challenges the tuning fork methods.

Early in the use of the commercial audiometer certain men very violently attacked the instrument and its use because of its price. Today this second (price) deterrent to the acceptance of the audiometer is being relegated to the background. The price of a piece of apparatus should in no way be a factor in determining the desirability of its use in clinical medicine.

Having zealously espoused the use of the best procurable tuning forks many years ago and having constantly used them in the examination of patients, I feel that I am in an impartial position on tuning forks. Also because for many years I have used the Western Electric 2-A audiometer as an additional diagnostic agent in the examination of patients, I believe I am in a position to evaluate the importance of the audiometer in otology. It is my conviction that at the present time both good tuning fork tests and an audiogram are essential in the examination of otologic patients.

The early audiometers had only an air conduction receiver, which in my opinion is the important clinical feature. My experience leads me to believe that with an audiogram made with an air conduction receiver and three or four simple tuning fork tests, which can be made very rapidly, as satisfactory results are obtained as if a bone conduction receiver is used in addition to the one for air conduction. The method of having an audiogram made and then following it with the Weber, Schwabach and Rinné tests will give as satisfactory results as any method with which I am acquainted, and it certainly has a great advantage in conservation of time. However, time saving should not enter into a consideration of clinical methods. I am certain that many of us have made the observation that an individual has to be either well developed mentally or pretty dull to readily answer regarding tuning fork tests, that is, it is difficult for the average individual to submerge

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what he knows or thinks he knows in any subjective examination. It has been my observation that the use of the bone conduction receiver is apt to confuse not alone the patient but the otologist as well. At this time I should advocate for clinical work an air conduction receiver audiogram with tuning fork tests.

The question of where the audiometer may be used satisfactorily has been rather extensively discussed, and while I feel that there would be considerable advantage in the use of a sound-proof room or booth in research, I can say from personal experience over a period of several years that audiograms and tuning fork tests can be satisfactorily done in the ordinary inside office which is not exposed to any unusual noise. I have checked a sufficient number of patients to know that there will be very slight variation in their response in the ordinary room, so one should not be deterred from the use of the audiometer by the failure to have a sound proof room or booth. If one religiously follows patients with audiograms made in the average inside office, one will be well compensated for its use.

Within the last year or two another very important use of the audiometer has been developed, that is a more accurate adaptation of hearing aids to the individual patient. It is possible with accurate audiometry to more correctly choose a type of hearing aid for the deafened individual. This development of the use of the audiometer has led me to wonder whether commercial pressure may not cause some of us to advocate the use of hearing aids by individuals who could be better managed without them. Certainly this feature in the use of the audiometer will be a very definite factor in the development of audiometrists, who will, if I read the advertisements in the daily press correctly, sell hearing aids to many individuals who would be better served by the otologist. However, this should in no way deter one from recognizing the value of this apparatus. Only time will work out the proper place of the hearing aid among deafened people. When we consider the wearing of a hearing aid the same as on a par with the wearing of glasses, I wonder whether we are not carried away by our enthusiasm.

Comparative Value of Audiometer and Tuning Forks

It is my practice to have an air conduction audiogram made of every individual who complains of a hearing loss. This audiogram is made before anything else is done to the patient other than a simple inspection of the external auditory meatus to see that they are not obstructed by impacted cerumen, cholesteatoma, and the like. I think it is essential that we do this before the patient is examined, otherwise there may be some distrust of the audiogram. At the same time I make a Weber test with the capital A fork and a Rinné and Schwabach test with the small A fork. Then I believe that the patient is ready to have a careful inspection of the ears, nose and throat. The audiometer is a very efficient piece of apparatus to determine hearing for high tones and I have learned to suspect some nerve defect if there is a marked drop in the upper tones or a loss of one or two of the higher tones. From my own observation it seems that a marked drop in the 4096 tones and then a material recovery of the 8192 is sufficient to cause one to suspect some nerve lesion.

When one uses the audiometer and the tuning forks as I am advocating, one will learn that a sharp demarcation between conducting and perceptive hearing defects does not obtain as we thought it did. One who learned to interpret tuning fork tests from Bezold will have a rude awakening if he follows the method I am advocating.

If upon examination it is thought that there is hope for improvement of the patient's hearing after a definite outline of management, another audio-

gram should be made to determine the effect of treatment. It is very gratifying to the patient and a satisfaction to the otologist to have a graphic exposition of the result of management of a hearing defect. It is not always necessary that the hearing be improved to demonstrate that the management of the patient is satisfactory. Frequently, stopping the progress of deafness is a result which should be strived for and the audiometer is admirable for the study of the effect of management of otologic patients. Never before its advent was it possible with any degree of accuracy to tell a patient from month to month or year to year that his hearing was decreasing, remaining stationary or improving. If this were the only aid afforded me by the audiometer, I would be well compensated for the time and effort which I have expended in its use.

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Discussion

Dr. Meyer Gorin (Rochester, N. Y.): It is only within the past few years that audiometry has proved of definite importance in the practice of otology. The otologist, until the present development of this instrument, had to content himself with an estimate of hearing loss by means of the whispered voice, tuning fork tests, and other instruments. These served to aid in the diagnosis of the various types of deafness, but did not give a very constant means of measuring and recording the degree of impaired hearing. This has been made possible by the standardization of the audiometer for both bone and air conduction, and when recorded, the findings give at a glance a comparatively true picture of the hearing defect.

One source of error in the audiometric examination for air conduction has not been mentioned. Due to the fact that the ear-piece must be placed directly against the ear, some of the sound must of necessity be conveyed to the cochlea through the cartilage, soft tissue, and to some extent, even bone. It may be said that the ear-piece is so insulated as to reduce this error to a minimum, but it must be admitted that this factor does exist. However, despite this the audiometer is a definite advance in the armamentarium of the otologist.

As pointed out, with this more exact means of measuring hearing loss, the otologist is now in a better position to suggest and prescribe various forms of hearing devices in accordance with the degree and type of deafness. The scientific building of the hearing aid was formerly impossible due to the lack of accurate information regarding the patient's hearing defect as is now obtained by the audiometric examination. Without this the fitting of necessity resolved itself into a trial and error method rather than the scientific basis upon which it now rests.

It was stated that "commercial pressure might cause the otologist to advocate the use of hearing aids by individuals who could be better managed without them." This is obviously the course of least resistance, and I doubt if any competent otologist would advise the use of such an instrument unless definitely indicated. Prescribing a hearing device does not mean that treatment, if indicated, will not be continued, at least as the essayist suggested, in an attempt to stop the progress of the deafness.

One might infer from all that has been written concerning the audiometer, that an

examination with this instrument is a final means of arriving at a diagnosis of the various ear conditions. This, however, is by no means true. The audiogram merely gives us a picture of the patient's hearing status and indicates to some extent the type of affection present.

We cannot disregard, however, the important information obtained from the Schwabach, Rinne, and Weber tests. The final otologic diagnosis must be based on complete tuning fork tests, examination of the vestibular apparatus, the audiogram, and a thorough study of the ear, nose, and throat.

Dr. Frank E. Bryant (Minneapolis): Dr. Mundt's attitude concerning the use of both the tuning forks and the audiometer may be a matter of personal opinion to some. I think it may be safely stated that though during the past few years, the audiometer has been developed, the use of the tuning forks should not as yet be discarded.

I am glad Dr. Mundt mentioned the audiometrist. The problem exists and must be recognized. If the otologist does not, or slowly accepts the rightful place of the audiometer in his practice, many individuals with deficient hearing, will fall into commercial hands. They will be sold hearing aids when thorough clinical and laboratory studies would have obviated such a purchase. The audiometer is an adjunct and a most important one but one which must remain just that. The otologist must be the investigator and the final court of judgment.

The audiometer has one role which is most important, and which was not mentioned by Dr. Mundt. That is the use in children for the early detection and amelioration of deafness in its relation to speech defects and educational difficulties. The National Committee composed of Coates, Dean, Fowler, Hayden, Jones, McFarland, Newhart, Shurly and Wherry have done much in this regard, and their efforts are to be lauded. At the University of Minnesota we have a very personal interest, because my colleague, Dr. Newhart, has taken a most active interest in this phase of work, especially in Minneapolis and Minnesota. According to Newhart, of 10 million individuals in the United States, who are hard of hearing, 3 million are children. Of these, three hundred thousand are definitely handicapped. This number would be greater if more accurate and extensive study by audiometric methods were employed. As an important trend in the use of the audiometer, there is need for the wide use of two types. To quote Dr. Newhart, one is for research and use in dealing with the severely deafened, and the other equipped with a simple, reliable, pure tone by air conduction with a range of 128 to 8,192 DV. Large groups may be screened and impairment thus detected. These individuals should be referred to the otologist for further and exhaustive study and indicated management.

Dr. Austin A. Hayden (Chicago): I agree with Dr. Mundt that tuning forks are of use but I believe for all purposes an audiometer is better. An audiometer really is an electrical tuning fork with the distinct advantage of increasing or decreasing sound at will. The tuning fork has its maximum sound at the moment of impact and then rapidly decays in a fixed curve. For that reason audiometers are controlled tuning forks with many advantages over the latter and promises to come into such general use that it will supplant this older method, except perhaps for the sole purpose of determining by the beat of the tuning fork the accuracy of the pitch of the audiometer. It is interesting that the Riverbank Laboratories which manufactures most of the tuning forks used in the United States, is looking forward to just such an eventuality.

It is true that soundproof rooms should be used more generally, but not to the exclusion of "quiet" testing rooms. In the absence of a subway and in the presence of the Elevated, with the street cars running and the elevators making all kinds of noise, no hearing tests could be made in the average offices in the Chicago loop. So we must do the best we can with what we have — i.e., "quiet room." My own testing room, which is an inside office as Dr. Mundt specifies, has an average sound level of 26 decibels. Only good ears are disturbed by this amount of noise. As a rule only defective ears are tested. This arrangement is quite satisfactory and the results fairly consistent.

My experience is that all of the hearing aids companies, whose products are accepted by the Council on Physical Therapy of the American Medical Association, believe that a misplaced hearing aid — one that is fitted to a person who is not improved thereby to the satisfaction of the purchaser — is the company's worst advertisement. These manufacturers are trying to do a legitimate business and they are actually doing very fine work for the most part.

Just exactly in what kind and what degree of hearing loss such aids are indicated is very difficult to determine in the abstract. Even in the individual case, it is not easy. I think the hearing of everyone in this room could be increased by a hearing aid. But most certainly not everybody in this room should or would wear one, however, because not everybody needs or wants to hear better than he does. Nature has equipped the human with a superabundance of hearing but I think the premise that even normal hearing can be increased, can be made hyperacoustic, with a hearing aid is absolutely true. Indications for hearing aids were tentatively set up in my paper before the Section of Oto-Laryngology at the San Francisco meeting of the American Medical Association. As experience and instruments change, these will be revised.

Dr. Mundt's use of consecutive audiograms with or without the hearing aid is of value for clinical study and comparison. When the record shows improvement, the patient is always pleased.

Sound leakage that Dr. Gorin speaks about, from the air receiver into the temporal bone is true but only in cases of severe deafness. The bone threshold of hearing is 45 decibels above the air conduction. So that no sound of less intensity

than 45 decibels could go back into the bone because the bone "just can't take it." In the higher defects there is such a possibility, but so far as I know there is no way to exclude that absolutely.

It is interesting to me to know that some types of sound acoustic barriers, for instance sponge rubber, under certain circumstances will act as transmitters of sound instead of barriers, and what Dr. Gorin says about the thorough investigation of the ear, nose and throat particularly is absolutely correct, and I would add that a psychological examination of the patient, in fact, a general physical examination is often very much in order, if not indeed always.

Dr. Bryant mentions early detection of hearing loss as being very important. This can be done better with an audiometer than by any other method. I am grateful to him for his statement about the appreciation of the efforts of the Council on Physical Therapy.

Dr. Horace Newhart (Minneapolis): I wish to congratulate Dr. Mundt on his admirable presentation of this very timely subject. It is refreshing to note the increasing interest which is shown in this work.

Regarding soundproof rooms I wish to say for Dr. Hayden's consolation that we are expurgating from our vocabulary the word "soundproof" as related to rooms used for practical hearing tests. The terms "noise proof" or "noise excluding" are preferable. What is needed is a reduction of the noise level to the point of keeping out interfering or distracting sounds. This is attained in a practical way by the careful application of acoustic treatment. It i very essential in offices and schools i downtown districts if we would make hearing tests sufficiently accurate for diagnostic purposes and to detect slight, easily overlooked but significant hearing deficiencies.

Dr. Mundt made the statement that it is practical to check with a bone conduction receiver only those patients who complain of or have noticed a hearing loss. I raise the question, why waste valuable time by waiting until they notice their defiencies? It is our practice at the Ear Clinic of the University of Minnesota and in our office when possible, to get an air conduction graph of all persons who have any disturbance of the upper respiratory tract or other conditions which might cause hearing impairment. Among these we very frequently find a very definite, sometimes a severe defect of which the patient was not aware.

In the preparation of a thesis not yet published, Dr. Fritz Hurd, one of our teaching Fellows, discovered that of the students in the University of Minnesota Health Service having a significant hearing loss, 67 per cent, were not at all conscious of their defects.

Regarding the importance of bone conduction, I feel personally that for prescribing or selecting hearing aids, research and in testing pupils in our schools for the deaf to determine their residual hearing, the use of bone conduction is important. As regards its use in routine practice for simply detecting hearing deficiency, I quite agree with Dr. Mundt.

Dr. G. Henry Mundt (closing): I appreciate Dr. Gorin's discussion, but from my title I did not feel that I was justified in going into the subject of the use of the audiometer for group examination of children. I appreciate the importance of it and was responsible for its placement in the Gary schools a good while ago and have watched it with a great deal of interest. I think there are few places where children have been better handled so far as examination is concerned than there.

Relative to the pressure for hearing aids Dr. Gorin spoke of, I am always a little skeptical about agents who come to me with the request to get six or eight or ten people together, so that they can bring their apparatus, test them and fit them up with hearing aids. Maybe those are business methods, but they are not professional methods. There is too much pressure in the sale of hearing aids.

Dr. Gorin mentioned testing the static labyrinth along with the use of the audiometer. Jones and Knudsen spoke of that in their paper. I have heard of it and I just do not grasp it. It does not appeal to me as important for the average individual who complains of deafness or who has an audiogram made to test the static labyrinth. I think I was in error. I think it was Dr. Bryant who spoke of the use of the audiometer in the examination of children. I said it was Dr. Gorin. I think it was not.

Dr. Hayden is perfectly correct when he says that the audiometer is an intensified tuning fork, a glorified tuning fork, but I still think there may be some disadvantages to that glorified tuning fork. I have a complete set of forks. If you will give me three or four forks, I will get along pretty well with an air conduction receiver.

I was glad to hear what Dr. Hayden said about this noiseproof — no, what is Dr. Newhart's new word?

Dr. Hayden: It is "noiseproof." We used to use "soundproof."

Dr. Mundt: I once had a room built, celotex lined, and then I had a second window put in a room which is nearer the street than this noiseproof room was, and we can do much better in that room with two windows than we can in a noiseproof room because we don't get a rumble that is general in that building.

Dr. Hayden: You don't suffocate yourself either.

Dr. Mundt: No, because I have an air pilot in that room with the two windows and it works beautifully.

I agree with Dr. Newhart that we should more generally examine our patients relative to their hearing. We make audiograms only on those whom we can and that means whenever such a test is indicated.

CANCER OF THE HEAD AND NECK

Management of Lesions with Borderline Operability and Curability *

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Early, localized, readily accessible cancer is curable. Late, extensive, inaccessible, and metastatic neoplasms are inoperable and incurable. Modern oncologic methods permit active treatment of lesions which were formerly considered hopeless. Remarkable advances have been made in diagnostic, radiotherapeutic and electrosurgical technics. It is now possible to prolong life, relieve suffering and even cure patients who were formerly classed as doomed.

Improvements in Diagnosis

Biopsy is now almost universally employed as the first step in the diagnosis of cancer, whenever the neoplasm is at all accessible. Routine physical, serologic and radiographic examinations with appraisal of the onset, rate of growth, location and probable extent of the lesion should permit an accurate diagnosis of type and grade of malignancy in approximately two-thirds of all cases of cancer.[1] Efficiency in diagnosis is increased, however, to more than ninety per cent accuracy if biopsy can be done and the surgical pathology of the growth correctly evaluated. Practical oncologists stress the value of microscopic diagnosis and control of treatment in all cases where the study is at all feasible. Radiologists as well as surgeons recognize the importance of pathology in its revelation of the life history of the growth as of paramount value in the control of treatment. Radiologists, in particular, are gradually losing their fear of biopsy. Electrosurgical biopsy[2] is widely employed as a safe and satisfactory technic for the accomplishment of the following objectives:

1. Electrosurgical excisional biopsy for the total ablation of low grade localized readily accessible neoplasms.
2. Electrosurgical resection of the advancing edge of a cauliflower, ulcerated tumor, to determine the type and grade of the growth.
3. Electrosurgical resection of the major portion of an otherwise inoperable tumor, prior to the application of radium or x-rays. By this technic, not only is valuable information obtained as to the cellular components of the growth and its bed, but any infected material that may serve as a barrier is effectively removed.

While we consider electrosurgical biopsy as of most practical value from the standpoint of safety and efficiency, other methods should be employed when indicated. Biopsy by a sharp cutting instrument, knife, curet or punch technic gives excellent histologic material if the site is correctly chosen. There is little hazard of implantation, if the wound is cauterized or coagulated. Aspiration biopsy, through a large bore needle, has proven of some value. Frozen section biopsy has been so thoroughly established that it need be merely mention at this time. In every case, however, the final judgment as to the surgical pathology in question, should not rest upon one single slide, following a casual study of the gross specimen. Surgical pathology consists of much more than study of the removed specimen. The pathologist should be a

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clinician and understand the problems of the surgeon and radiologist. The clinicians should work in close cooperation with the laboratory. Such reciprocation as now obtains in the well organized oncologic clinic is necessary in the management of cancer with borderline operability and curability. It should be effective from the time the patient is first seen, with the initial diagnostic steps, including the biopsy. It should continue through the various therapeutic stages, as indicated by the nature of the lesion. Although either of the three stages may be omitted, the management of cancer with doubtful curability consists of preoperative radiation, operation with the aid of electrosurgical technic, and postoperative radiation. From time to time, follow up or "check" biopsies are of great importance in the advanced so-called incurable cases.

Plastic repair of the defect left after resection of cancer in the head and neck is better not begun until a follow-up biopsy proves negative. In the management of some cases of cancer, prior to the first biopsy, preoperative radiation may be advisable. In these cases the oncologist must make due allowance for the modified histologic character of the lesion due to prior radiation. Chronologic variations in grade and even type of cancer are met with from time to time. Mixed type growths[3] are not infrequently seen, which explains failure of complete regression in some cases of borderline cancer that had previously been treated by either x-ray or radium or both. It is for the above reasons, largely, that modern oncologic treatment demands biopsy as the initial step in the management of all neoplasms accessible to electrosurgical technic. As a final argument in favor of routine biopsy study, it may be incontrovertibly stated that statistics as to cure of cancer are of little or no value, unless the diagnosis has been verified by the microscope.

Improvements in Radiation

Among the many advances in radiotherapy, the most outstanding are those based upon scientific correlation between histogenesis and radiation response.[4] Modern radiotherapy is largely based upon surgical pathology of the growth. Combined methods of electrosurgery with radiation have proved of great value in the management of head and neck cancer with borderline curability. A caustic dose of radium is required for the cure of localized cancer of low grade anaplasia. Electrosurgical biopsy is recommended as a superior technic for this type of growth. Localized high grade neoplasms may also be treated by electrosurgery. The more extensive highly anaplastic tumors should never be denied the benefit of thorough irradiation. Mixed cell patterns of both low and high grade anaplasia, indicate the advisability of both surgery and radiation. We may conclude then, that the factor of radiation response must be evaluated in all neoplasms, including those of borderline curability. We should not conclude from these facts, however, that all cases of cancer of the head and neck, even those of borderline curability, should be relegated to the radiologist. The surgical pathologist should share responsibility with the radiologist, not only in evaluating the histogenesis of the growth, but also in contributing his share of the work required in the eradication of the neoplasm.[5]

Improvements in Operative Technic

Among the outstanding improvements in oncologic therapy has been the evolution of electrosurgery. The cardinal principle of complete extirpation should be followed whenever at all possible. While it may be stated that electrosurgery is less likely to be followed by dissemination of the growth than classic operative technic, nevertheless an effort should be made to excise

the neoplasm whenever possible. Not only should the line of excision pass through normal tissues paradjacent and subadjacent to the neoplasm, but also an appreciable part of the tumor bed should be removed. This cannot always be accomplished by electrosurgery with safety to important parenchymatous structures. In the head, we are limited in operating in the neighborhood of the cribriform plate and the pterygopalatine fossa. Similar limitations exist in the hypopharynx and along the great cervical vascular trunks. Complete ablation of metastatic cancer in the neck is impossible by any form of operative technic. This is notably true when the growth has originated in the mouth and has become widely disseminated along the deeper lymphatics. If the growth has remained localized in the upper cervical nodes, or in the submaxillary gland, the lesion may be considered of borderline operability and curability. Electrosurgical resection is occasionally curative in this situation. Prior ligation of larger blood vessels, preoperative and postoperative radiation, sequestrectomy and plastic repair are factors of equal importance to electrosurgery in the management of cancer of borderline curability. In extensive low grade neoplasms of the head and neck, tracheotomy and gastrostomy may aso be required.

Eradication of cancer from the head and neck demands fortitude, and better than average knowledge of the surgical pathology and anatomy of this region. Irrespective of the technic employed, whether electrosurgery or classic operation, or a combination of both, the operator should endeavor to carry out the surgical axiom: "Do the adequate resection at the first operation." Ultraconservatism is fatal in the management of cancer. Whenever we are over-conservative at the first operation, we will be compelled to be just that much more radical under less favorable conditions in dealing with the inevitable recurrence. This is true, even when electrosurgery is employed on lesions that should have been readily cured at their early stage.

The management of cancer of the nasal accessory sinuses was discussed at a previous session of the Congress. The importance of radiation combined with surgery aided by electrosurgical technic was then emphasized and is now repeated. Our best results have been obtained in epidermoid cancer which had originated externally. Radioresistant basal celled cancer which had infiltrated the orbit and diploic tissue of the skull, was amenable to radical electrosurgical resection, but only in direct proportion to the depth of infiltration. Biopsy in such cases not infrequently shows basal-squamous cancer.[3] This type cannot be differentiated clinically from ordinary rodent ulcer. It is much less likely to regress under radiation than ordinary basal celled cancer. For this reason, biopsy before radiation of epitheliomata about the orbit, nasolacrymal duct and nasofacial juncture, is important. Electrosurgical excision is curative in these lesions in almost every case.

Borderline Buccal Cancer. — The present trend in oncologic clinics is to avoid surgery in buccal cancer. Whether originating in the lip, buccal, alveolar or lingual mucosa it is most commonly squamous epithelioma in type. Buccal cancer varies in grade of malignancy in its various locations. When in its precancerous stage as papilloma or leukoplakia, and also in its early low grade localized stage, the growth is readily diagnosed and cured by electrosurgical excision. When located in the posterior third of the tongue, or when it has infiltrated through the floor of the mouth or into the hypopharynx, the operator will save himself and the patient much grief by employing radiation rather than surgery.

Radiation, in addition to electrosurgery should be employed in epidermoid cancer of the upper jaw. Lesions in this situation which should be classed as of borderline curability are those which involve the posterior third of the alveolar arch with probable infiltration not only into the antrum but

also the pterygopalatine fossa. Cancer may extend upward from this source into the ethmosphenoid cells and orbit. In such borderline cases, combined radiation and electrosurgery is occasionally successful. Since this type of cancer seldom metastasizes into the neck, and since upward extension is slow, early radical removal should be carried out, followed by the indicated radiation. The same may be said for epulis, and perhaps also for adenocarcinoma of the palate.

Cancer of the lower lip, predominant in males, is most often a low grade squamous celled epithelioma. Excellent results are being obtained by interstitial radiation; also by the Pfahler technic of electrocoagulation of the primary growth followed by fractional doses of x-ray to the cervical lymph nodes. Electrosurgical excision is curative for cancer of the lip in the very cases which are considered ideal for radium. The cosmetic end result is in most cases better after radiation. If the growth is still superficial to the orbicularis muscle, however, electrosurgical excision not only gives a positive cure, but the five year end results compare favorably with radiation, not only as to cure but also in a cosmetic sense. Generally speaking, the cosmetic factor is of secondary importance in the management of cancer. This is certainly true in buccal cancer which has extended into the neck.

In *the management of metastatic cancer of the neck,* the lesion should always be considered as of borderline curability if one or two firm nodes may be palpated in the submaxillary region, and when they are not firmly fixed. Preliminary biopsy should be done. Syphilis should be ruled out. Depending upon such factors as prior radiation, the decision is made as to immediate exploration of the neck under frozen section control or the use of further x-ray treatment to the neck. The primary growth should be resected by electrosurgery. Resection should be wide enough to produce a local cure, even though subsequent plastic repair will be required for closure. If the cervical mass can safely be resected by electrosurgery, the operation is curative in many cases. It is not wise to do extensive block dissection in the neck for epidermoid cancer originating in the mouth. If the cervical mass is malignant and resection proves impracticable, a radium capsule may be inserted and left within the wound, or interstitial radium may be employed.

Block dissection of the neck, with resection of the sternomastoid muscle and the internal jugular vein may be successfully employed for cervical extension of malignant growths that have arisen within a mixed tumor of the parotid gland. This lesion is classed as of borderline curability and treated by surgery for the following reasons: — (1) The onset of the malignancy is delayed, arising within an encapsulated tumor, from which extension is comparatively slow. (2) Tumors of the parotid gland are notoriously radioresistant. (3) Recurrence may be successfully attacked should the first operation prove incomplete. It is re-emphasized that these factors do not apply to cervical metastasis of primary buccal cancer. Hence the inadvisability of extensive surgery in the attempted eradication of epidermoid metastatic cancer in the neck.

These observations are largely based upon my own experience in private and clinical practice during the past fifteen years. During this time the field of oncology has been in a state of progressive evolution and improvement. Combined methods of treatment and co-operative teamwork between the surgeon, pathologist and radiologist are now more widely and successfully employed. We are now able to control these borderline cases, where formerly they would have been referred by the surgeon to the radiologist, by the radiologist to the electrosurgeon, and vice versa. Our records show an ever increasing number of five to ten years survival in patients, who, when first seen were classed as hopelessly incurable.

We are not as yet ready to quote statistics. Approximately fifty per cent of our borderline cases have survived five years. It is obvious that in approximately half the cases whom we endeavored to save from an otherwise hopeless condition, statistics could be quoted as "cured." Statistics as to "cure" of cancer are generally unreliable. As a matter of human interest, we can offer these combined methods of radiation and electrosurgery to patients with cancer of borderline curability, as a hopeful even though not optimistic plan of attack against an otherwise insurmountable situation. Many, but not all patients, when offered this "fifty-fifty" choice, courageously co-operate. Most patients derive some benefit from active treatment. With occasional exceptions, their septic ulcerated growths are sterilized, local recurrences are held in abeyance, and they are spared suffering and social ostracism that otherwise would have been inevitable.

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Discussion

Dr. Thomas C. Galloway (Evanston, Ill.): One cannot intelligently outline the treatment of these cases without knowing exactly their histologic picture. Biopsy of course has its limitation, but I think no one should treat carcinoma without knowing its histologic characteristics. If it is small, one can get a histologic report after its removal.

The indications and relative advantages of electrosurgery and radiotherapy are clear. I started out doing only electrosurgery because I had no adequate radiotherapeutic apparatus available, and one must bear in mind that there have been improvements in the technic of electrosurgery as there have been in radiotherapy. We have three main criteria. One is the histologic picture which Dr. Kime has so well discussed. If the tumor is of low grade malignancy, mature form, grade 1 or 2, the indication is for surgery. If it is anaplastic, if it is a grade 3 or 4, if it is a transitional cell carcinoma, or a lympho-epithelioma, then I think we should place our reliance on irradiation.

The location has a good deal to do with the virulence of the tumor because it probably is related to the parent cell from which the malignancy arises. I would give more of the skin cancers, the small skin cancers at least, to the radiotherapist because of better cosmetic results. Certain tumors I would not now subject to electrosurgery. Carcinoma of the tonsil is curable in 24 to 28 per cent of the cases by irradiation. I have cured one case by electrosurgery, but in the light of present experience I should never attempt another one. That includes also for transitional cell carcinoma, lympho-epithelioma of the nasopharynx, or hypopharynx. It applies to tumors of the base of the tongue. Tumors of the anterior third of the tongue, especially if they are of low grade malignancy, papillary or fungating, can be cured by electrosurgery. Tumors of the lip and cheek perhaps will require combined therapy. Certainly tumors of the antrum I think should have combined therapy. There are no better results available than those of about 38 per cent cures by combined therapy.

A word should be said about carcinoma of the larynx. The radiotherapist has discovered that by using proper fractional doses he can treat carcinoma of the larynx without very bad results. I do not think that from any statistical information we have it is justifiable to commit a small, movable, unfixed tumor of one cord of the anterior third, or both cords even, to radiation therapy when by laryngofissure, which is an eminently satisfactory operation, one can insure a good voice and a normal airway and cures ranging from 80 to 88 per cent.

Just a word about preoperative radiation. I think there is seldom any indication for that, because one cannot carry a course of radiation therapy to its conclusion before operation. Now it is quite a different picture when radiation therapy has failed, because there are some cases which attain the brilliant results as Dr. Kime has shown with electrosurgery. Postoperative radiation we do not use, except perhaps in the antrum, unless we

have definite evidence of recurrence. X-ray or radium should not be used in a careless or casual or in an inadequate manner, and unless one obtains a positive biopsy or signs of recurrence one is not going to give postoperative radiation therapy to the fullest satisfaction.

Dr. A. D. Willmoth (Louisville): There are two or three points to which I should like to call attention. One is thoroughness. If you cannot proceed radically with cancer, then don't attempt it. It does not make much difference about the cosmetic effect so long as the question of life is at stake. If you are going to regard the cosmetic factor too seriously, then you should not attempt electrosurgery.

The other thing is as the doctor just said, "Educate the public and educate many doctors who, unfortunately, tell them not to bother the tumor until the tumor bothers them." Breast cancer is sometimes seen early, and they will advise the woman to let it alone. You know what that means, when she comes to the surgeon she has a metastasis into the arm pit and above the clavicle. Then comes that case for which nothing can be done. The type with most offensive odors. We have a simple measure to check this — sugar, preferably powdered sugar because it is not sharp and sandy like granulated sugar — and can be moistened to the consistency of paste and spread on a cloth as a dressing. One or two applications of sugar a day will keep the growth clean, and the hospital will not be objecting to the odor about the wards.

In vaginal cases I use just ordinary Karo syrup. I tell the patients to take a teacup to a quart of water and use it as a douche, and I keep these patients just as clean as any others I have in the hospital. It is the one way to keep these patients clean and without odor in their homes until death ends the scene.

Dr. Edwin N. Kime (closing): I have already used my closing time in the original discussion; therefore, I won't add anything more except to say that the paper as it will be published will discuss a number of these lesions about the floor of the mouth and the hypopharynx. I fully agree with Dr. Galloway that you will save yourself and your patients a great deal of anxiety if you will avoid those places with electrosurgery, especially if you have to open up the pharynx.

ROENTGENOTHERAPY OF ENDOCRINOPATHIES *

JAMES H. HUTTON, M.D.

CHICAGO

Clinical endocrinology today is keenly appreciative of the therapeutic value of the x-rays in many glandular disturbances. The field has become so large that I shall confine my observations mainly to the management of the pituitary, gonads and adrenals with particular reference to their interrelation. This does not imply that other types of endocrinopathy are not amenable to x-radiation.

Beginning with hyperthyroidism it is of interest to point out that roentgenologists,[1] regard this condition from the same restricted viewpoint as the surgeons; that is, as purely a disease of the thyroid and accordingly restrict their treatment to this gland. Certainly by this time most of us can agree that so-called hyperthyroidism often is not a disease of the thyroid at all and is better treated by attacking the pituitary, the adrenals and even the gonads. We have a number of patients in whom the syndrome entirely cleared up or was completely held in abeyance by small doses of roentgen rays applied to the pituitary and adrenals. The thyroid was not treated at all.

Dysfunction of Genital Organs

Menstrual disorders — amenorrhea, oligomenorrhea, dysmenorrhea and sterility — have all been successfully treated by irradiation of the pituitary or the ovaries or both. In my opinion the results are better if both regions are irradiated. Various technics and dosages have been used by different

* Read at the Seventeenth Annual Session of the American Congress of Physical Therapy, Chicago, September 15, 1938.

clinicians. My own experience has been with the application of very small doses, usually 120 kilovolts, 3 milliamperes, delivering 50 r units to each side of the pituitary and through a common portal to both ovaries.

The same factors can be used to relieve symptoms of the menopause. In these cases the pituitary and the ovaries should be irradiated, and when this is not successful, the pituitary and adrenals should be subjected to this therapy.

In functional bleeding slightly heavier doses may be needed, although I have seen cases controlled by the same low dosage. This raises the question how roentgenotherapy accomplishes its results. Doses are referred to as deep roentgenotherapy, low dosage irradiation, and stimulating dosage. My own impression from clinical observation is that the effects are probably regulatory; that is to say, they might in one instance stimulate some organs and in another repress overactivity. Their exact action is of less importance to clinicians than a knowledge that they are effective in these syndromes. It is hoped that physiologists and physicists will discover their modus operandi.

Many roentgenologists use heavier doses applied to the ovaries to induce the menopause and complete and permanent cessation of the menstrual periods. This is a procedure to which I am strongly opposed for the reason that vasomotor and nervous symptoms of the menopause are very much more severe and prolonged when it is brought about in this way. Furthermore, when the menopause has been induced by irradiation of the ovaries, its symptoms cannot be relieved by irradiating the pituitary and ovaries, but only by irradiating the pituitary and adrenals, and even then the results are less satisfactory than is the case when the menopause occurs naturally. It should be remembered that many of the symptoms arise from disturbed function of the pituitary and adrenals consequent upon the withdrawal of the inhibiting action of the ovarian hormones. I have never seen a case in which the menopause was induced in which the symptoms were not severe and prolonged, although roentgenologists tell me those are the exception and not the rule.

Undoubtedly roentgenotherapy should be used more often than it is in treating menstrual disorders. Cases of amenorrhea and dysmenorrhea can sometimes be completely relieved by a few roentgen treatments when prolonged use of gonadotropic and estrogenic preparations is not successful.

It is my impression that neurosurgeons are inclined to give the roentgenologists more latitude than formerly in the treatment of pituitary tumors. Certainly the endocrinologists are disposed to use the x-ray much longer before calling in the surgeon. The time limit does not permit discussion of the reasons for this changing attitude. In my opinion it is a constructive change and one in the best interest of the patient.

A few cases of Addison's disease have been reported as showing considerable temporary improvement following irradiation of the whole body.[2, 3, 4, 5]

Essential Hypertension

A few endocrinopathies are associated with, and presumably responsible for essential hypertension. The most common of these are acromegaly, pituitary basophilism, adrenal tumors and hyperthyroidism, particularly that variety associated with adenomatous goiter. All of these conditions are due to hyperfunction of the gland involved. Ali but the adrenal tumors can usually be relieved by roentgenotherapy.

For a long time hypothyroidism has been known to be occasionally associated with essential hypertension which could be corrected by appropriate thyroidtherapy. Lately we have seen cases of hypertension in patients who

were also victims of combined thyroid and pituitary deficiency. Within an hour after the subcutaneous injection of 5 minims of obstetric pituitrin, the systolic blood pressure in one of these cases dropped from 180 to 140. Later the subcutaneous injection of 5 minims of antuitrin was followed by a comparable drop in blood pressure. Daily injections of 5 minims each of antuitrin and pituitrin were then given with adequate doses of thyroid. The blood pressure soon returned to normal and stayed there. The obesity was satisfactorily reduced and the signs of cardiac embarrassment also disappeared. A similar experience has been had with other patients.

There is a great deal of evidence from the fields of experimental physiology, medicine and surgery, as well as from pathologic laboratories, pointing to pituitary and adrenal dyscrasia as the causative factor in many cases of essential hypertension. Certainly the nephritic theory of essential hypertension should be abandoned. For more than a quarter of a century we have tried in vain to convict the kidneys of responsibility for this syndrome. Of course, if the hypertension exists long enough, the kidneys become involved; but probably the same factors which originally caused the high blood pressure eventually damage the kidneys. At any rate, victims of essential hypertension, cardiovascular-renal disease or whatever other name one may wish to apply to this syndrome suffer from a break at one of three points; kidneys, heart or brain. Fahr[6] says that 50-55 per cent die of heart failure, 35-40 per cent of apoplexy and 10 per cent of uremia.

Because of the well known effect of the x-rays on glandular function we thought it might be used to correct the pituitary and adrenal dyscrasia which we believed responsible for many cases of essential hypertension, with coincident return of the blood pressure to safer levels. For the last six years we have been irradiating the pituitary and adrenal regions of patients with this syndrome. The results so far obtained are shown in table 1.

TABLE 1.—*Results of Roentgenotherapy Hypertension*

Adequately treated			268
Improved	186	69.4%	
Relapsed	29	10.8%	
Remained improved	157	58.6%	
Unimproved	82	30.6%	
Insufficient treatment			59
Couldn't be followed			27
			354

Results obtained by other men using this therapy are shown in table 2.

TABLE 2.—*Results of Roentgenotherapy in Hypertension by Other Men*

	Number of Cases	Improved
Martin	100	80
Baker	40	30
McGuffin	40	30
Boswell	12	11
Finch	12	9
Konantz	6	3
Parkhurst	5	3
Hadley	4	4
Miscellaneous	56	47
	275	217

About 50 r are given to each side of the pituitary through a 10 x 10 cm. portal, and through a common portal 15 x 15 cm. a like amount is given to

the adrenals. Both organs are treated on the same day. The factors most often used are 120 kilovolts, 3 milliamperes, 50 cm. skin target distance and 2 mm. aluminum filter.

If there is no satisfactory fall in blood pressure nor relief of symptoms, the treatments may be repeated at intervals of a week until six have been given. However, if there is symptomatic relief and a marked fall in blood pressure after one or more treatments, no others are given until there is a rise in blood pressure or return of symptoms. In some cases one or two treatments a year have been sufficient to maintain the blood pressure at practically normal levels and to control the symptoms completely.

Some interesting phenomena have been observed.

1. Blood pressure may immediately fall as much as 40 or 50 points after the first treatment, or it may rise for as long as three days and fall after further treatment. Sometimes the diastolic pressure falls to approximately normal levels while the systolic changes but slightly. In other cases this procedure is reversed, the systolic pressure falling to fairly safe levels while the diastolic is affected but very little.

2. Symptomatic relief is out of proportion to the reduction in blood pressure and may occur when it is not appreciably affected. Headache is frequently relieved after the first treatment. This has occurred too often and too promptly after treatment to be attributed to coincidence or suggestion. The patients lose their sense of tenseness and irritability and claim a feeling of placidity which they have not experienced for many years. Vertigo usually is promptly relieved. Tinnitus does not yield so readily and in some cases has not yielded at all to this treatment. Precordial pain often disappears as does heart consciousness unless some demonstrable cardiac damage has already occurred. We have been under the impression that in some cases anginal attacks have been prevented or at least reduced in frequency. Confirmatory evidence that these observations have been true is furnished by Raab's[7] experience in treating angina pectoris by irradiating only the adrenals. He gave 600 roentgens to each adrenal and reports 40 of 58 cases considerably improved or entirely free from attacks. Blurring of vision usually ceases and retinal lesions improve or clear up entirely.

In some instances the blood pressure after a considerable fall returns to its previous high level, but the symptoms do not always return with the rise in blood pressure. Patients whose blood pressure is not reduced by this procedure become more sensitive to the nitrites, sulphocyanates and other drugs used in the treatment of this disease.

The symptomatic relief and change in blood pressure observed following this treatment is quite similar to that reported by surgeons following various operations on the sympathetic system and the adrenals. The relief following these various surgical operations is, at least in some cases, temporary, the blood pressure in about four months returning to its original level and the symptoms recurring with it. We have had one case under observation for four years which showed no symptomatic relief following irradiation, and while the blood pressure was reduced from 260/155 to 205/125, she could not be regarded as improved by this therapy. She underwent a bilateral splanchnicectomy and denervation with removal of a portion (about one quarter) of each adrenal. There was no symptomatic nor noteworthy blood pressure response to the first operation, which was followed in about three months by the second. Following this there was a temporary fall in blood pressure almost to normal levels (140/90). However, it remained at that level only a few days and then returned to nearly

its preoperative level. Beginning about a month after the second operation she was given further x-ray treatment, which was followed by relief of symptoms and a fall of twenty points in blood pressure to about 180/110.

Influence of Pituitary and Adrenals

The same evidence which implicates the pituitary and adrenals as causative factors in essential hypertension also points to them as causative factors in diabetes mellitus. There is practically no clinical or experimental evidence, nor can any of significance be had from the pathologic laboratories to support the pancreatic theory of diabetes. It is my impression that the physiologists have long since abandoned this theory. As clinicians we certainly should. This does not imply that we should change our method of treating patients with diabetes except that we should consider the syndrome as one that may arise from a number of causes and consequently should concern ourselves not only with the level of the blood sugar and its output in the urine, but also with any other endocrinopathies the patient may exhibit.

For years it has been claimed that various physical agents favorably influence carbohydrate metabolism. Pincussen[8] has shown that irradiation of the body with ultraviolet and visible rays has an action similar to that of insulin. The grenz-ray has been shown favorably to affect carbohydrate metabolism[9]. Diathermy of the pancreas is reported to have improved the carbohydrate tolerance of a series of patients suffering from diabetes.[10] Barnes[11] showed that, under the condition of the experiment at least, exposure of the pituitary and adrenal regions to small doses of x-ray improved the carbohydrate metabolism of pancreatectomized dogs, while the use of larger doses reduced their tolerance, which was improved but little after later use of small doses.

Approximately 10 per cent of patients with hypertension also have diabetes. It is not always possible to find out which came first. In some of our cases it was one and sometimes the other. Patients who are victims of both of these conditions have responded particularly well to irradiation of the pituitary and adrenal regions, as is shown in table 3.

TABLE 3.—*Irradiation of Pituitary and Adrenals in Hypertension and Diabetes*

Improved as to both conditions	13
Improved as to hypertension only	7
Improved as to diabetes only	4
Improved but relapsed	1
Unimproved	2
Insufficient treatment	6
Not followed	1
	34

Most patients who have diabetes uncomplicated by hypertension have not responded so well to this method of treatment. However, a few have done very well. They have been able to discard insulin without further restriction of diet.

In the doses employed this method is an entirely safe procedure. Neither biopsy material nor postmortem examination has shown any sign of x-ray damage to the pituitary or the adrenals. No clinical evidence of pituitary or adrenal damage has been observed. There have been no burns and no loss of hair.

It is a procedure which should give the roentgenologist a commanding position in this field. As Harrison[12] says: "Irradiation will help to avoid unnecessary operations on the sympathetic nervous system, and operative interference should not be attempted until the effect of irradiation has first been definitely established. It is highly probable that the operation will prove ineffectual if irradiation has failed to secure any improvement."

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Discussion

Dr. John D. Currence (New York): The results which Dr. Hutton presents utilizing x-ray irradiation rather astound me. His work is certainly deserving of careful evaluation and further research. Although at first some of the statements seemed over enthusiastic I can appreciate a great deal of the reasoning used in reaching his conclusions. If this work remains consistent only in part Dr. Hutton will have indeed made a revolutionary contribution to medicine.

With regard to irradiation for menstrual disorders—that is amenorrhea, oligomenorrhea, dysmenorrhea, sterility, menorrhagia and menopausel symptoms all controlled by the same low dosage, where stimulation or repression of activity is explained on the basis that it is probably regulatory, I would like to ask Dr. Hutton to give us more details of the rationale involved?

Quoting from the paper "Certainly the nephritic theory of essential hypertension should be abandoned. For more than a quarter of a century we have tried in vain to convict the kidneys of responsibility for this syndrome." I would like to ask whether he really means responsibility for essential hypertension? I do not feel that we have placed the responsibility for essential hypertension on a nephritic theory.

However since the recent meritorious work of Goldblatt on Experimental hypertension the kidneys are implicated and he concludes it is due primarily to a humoral and not to a nervous mechanism initiated by the ischemia of the kidneys.

Page has shown that in dogs, hypophysectomy does not prevent the development of experimental hypertension due to renal ischemia, but that it does reduce the blood pressure in some animals with this type of hypertension. Goldblatt has shown that hypertension can develop in the absence of the medulla of both adrenal glands after moderate constriction of the renal arteries. I do feel that the adrenal cortical hormone undoubtedly is an important factor in essential hypertension.

Dr. Hutton's work certainly does offer promise of development in the discouraging field of essential hypertension.

Although I well appreciate that the hypophysis and adrenal glands do play a definite role in diabetes I would like to ask Dr. Hutton on what basis he can exclude the pancreas when we can produce the symptoms of diabetes by removal of the pancrease in dogs? Another factor to consider is that Barnes has alleviated to some extent the symptoms of diabetes in prancreatized dogs by injections of an estrogenic substance.

Dr. R. W. Fouts (Omaha, Neb.): I had the pleasure of hearing Dr. Hutton's presentation on this subject at Kansas City in 1935, and have since treated a small num-

ber of cases—about twelve or fifteen. The results were about the same as reported in this paper. About one-third were not benefited during the time they were under observation. While no rational explanation is forthcoming as to just why or how such a seemingly small amount of radiation could influence the glandular function of the endocrines, there is no question but that these organs are markedly affected by relatively small doses. Clinical experience has proved that organs and neoplasms react to roentgen therapy almost in direct proportion to their rate of activity, either physiological or biological. The more active in function or growth they are, the more readily they respond to roentgen radiation.

While Dr. Hutton gave the factors employed in each roentgen ray dose, he did not state the time interval between treatments or the number of treatments. I trust that he will mention this in closing.

Dr. James H. Hutton (closing): Regarding the rationale of the results obtained by the roentgenologist in treating menstrual disorders, I said that I did not know how the results came about. We only know that they do, which from the clinical standpoint is the important thing. I have a number of theories, but I think they are of no particular significance. It is my belief that it must have some regulatory effect on these structures, else how would it do one thing one time and the exactly opposite, apparently, the next time? But from a hormonal standpoint, those factors are not so far apart as they appear.

In mentioning the kidney, I meant that I thought we should abandon the nephritic theory of essential hypertension. I am perfectly familiar with Dr. Goldblatt's work and I do not see in his work anything that disagrees with my thesis. In his case he puts a metal clamp on the renal arteries and produces a renal ischemia. Eventually he gets renal damage. He uses a metal clamp which produces a renal ischemia with a secondary kidney damage. In the same way by irradiation and by changing the sympathectomies we can relieve the physiologic clamp which the body itself has put on there, which no amount of operative interference would influence in Dr. Goldblatt's case. At any rate, even when the course was not apparently greatly influenced, we have seen the renal function improved from a dye return of about 30 to a dye return of around 60 or 65 per cent, and that when the patient went ahead and died within the next two or three years anyway. So we are relatively certain that the kidney function does improve after this sort of management.

Dr. Rowntree told me some three years ago that when he was at the Mayo Clinic he became very much interested in treating hypertension by irradiation of the adrenals only, and that in one case he had a remarkable fall in blood pressure. He has also done some of this work. I had a letter from him a few weeks ago in which he said he had treated a few more cases with rather satisfactory results, and it is his feeling that the reason they attained results is because some change occurs when both the pituitary and the adrenals are irradiated instead of only the adrenals.

I have the same impression. At least I have seen cases where only the adrenals or the pituitary were irradiated and poor results followed where we had every reason to expect good results, which would probably have occurred if both had been irradiated at the same time.

As far as pancreatectomy and diabetes is concerned, I would say that even that bit of evidence favoring the pancreatic theory of diabetes is no longer sufficient. Houssay and others have removed the pancreas without causing diabetes when they first removed the pituitary. The experimental animal went ahead and metabolized a perfectly normal amount of carbohydrate. Obviously a pancreatectomy can be made to produce no diabetes. Barnes' own explanation of his work is that the pancreatectomized animal did not develop diabetes because the hormone suppressed the pituitary activity. So, undoubtedly, we should at least go far enough to realize that the body does not put the metabolism of so important a substance as carbohydrate in charge of one organ alone.

Of course, the pituitary extracts have brought about glycosuria and in some instances diabetes. Diabetes associated with pituitary basophilism is another thing. Cushing in his series of basophilism in some five or six cases, showed one that had had all of the diabetic therapy which could be given without controlling the diabetes which disappeared after the pituitary was irradiated.

As to the intervals between treatments which Dr. Fouts mentioned, we treat them at weekly intervals until six are delivered, unless there is a satisfactory fall in blood pressure either to normal or as much as 30 points after one or more treatments, in such cases no further treatments are given until there is a rise in blood pressure or a return of symptoms. I do not care whether it is a month or a week or a year, and in some cases it is more than a year after one treatment, but if there is no satisfactory fall, another can be given at weekly intervals up to a total of six. Presumably more could be given in the dosage used, but six is all we have so far used in any one series.

I appreciate what Dr. Currence said about enthusiasm. I hope that I did not sound enthusiastic. We have been at this work for six years, and have had some three or four hundred cases. I tried to present my views conservatively and if I failed to carry that impression, may I say now that we do not regard this as a cure-all. It does not raise the dead, it does not cure nephritis, it does not even cure essential hypertension, but I feel that it is a very worthwhile addition to our present methods of therapy.

X-RAY THERAPY IN OTOLARYNGOLOGIC INFECTIONS *

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Soon after the discovery of the roentgen rays, physicians began to use them for therapeutic purposes. With only results to guide them, a wide field of conditions was treated and many satisfactory results obtained by this empiric method. It was found, among other things, that pain was relieved in osteomyelitis and that the infection seemed to subside, thus promoting speedier recovery. Furuncles and carbuncles were also greatly benefited by x-ray therapy.

Tonsils

In otolaryngology, Witherbee[1] was one of the pioneers in treating hypertrophied, acute and chronic infected tonsils. He was followed by Osgood[2] who reported equally favorable results. Since Witherbee reported his results, numerous other authors have obtained the same satisfactory effects from x-ray treatment. Schulte[3] reported over one thousand cases with eighty per cent cures. Dubowyi and Lusers[4] reported one series of 163 cases and another of 700 cases with an average of seventy per cent cures. Similar good reports have been published by MacCready,[5] Knox,[6] Schonfeld and Baumbach,[7] Torres Carreras,[8] Wesley,[9] Wood[10] and others. In spite of this cumulative evidence, the method has not been generally accepted by otolaryngologists. The reasons for this may be that many of the favorable reports have been made by radiologists, that tonsillectomy is considered so simple an operation that the tonsil is completely removed at one sitting, while x-ray treatment requires several treatments and the good results are slower in making their appearance. At times, however, the results come with almost startling rapidity, as shown in the following case.

J. A. age 7. This boy had had two previous peritonsillar abscesses which had been incised but the tonsils had not been removed. Four days previous to our seeing the patient he suffered an acute attack of tonsilitis localizing on the left side, with swelling of the left tonsil beyond the midline of the throat. His temperature was 102 F., the white count 22,600. X-ray treatment was given and within forty-eight hours the temperature dropped to normal and the white cell count came down to 12,200. Treatments were continued daily until his temperature remained normal and once weekly until the tonsil had receded to normal size. In the meantime the patient's general condition improved from a pale sick boy to a pink lipped, happy, robust one.

In many patients where the results seem disappointing at first, as time goes by, the tonsils atrophy, the infection disappears and the patient, when seen a few months later, is in excellent condition. The large lymphoid type of tonsil gives the best and quickest results because of the radiosensitivity of lymphoid tissue and of the antibodies liberated which combat the infection. The tonsils are not removed but are converted to the adult type with resulting decrease in liability to infection.

The x-ray treatment has no mortality, is painless, requires no anesthetic, and no hospitalization. The small doses used produce no epilation, no change in the skin and no change in the mucosa of the nasopharynx. This method is especially indicated in adults suffering from chronic valvular disease, arteriosclerosis, nephritis or advanced arthritis, which might render them a poor operative risk.

Other advantages are that dryness of the throat does not occur, adhesions and fibrous bands do not form, scarring of the tonsillar pillars and

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palate does not occur, tooth buds, thyroid and thymus are not damaged because, under proper technic, they are not exposed.

Lymphoid islands on the nasopharyngeal mucosa, either primary or recurrent after tonsillectomy, are sensitive to x-ray and can be satisfactorily reduced by a few treatments.

In septic sore throat with a temperature of 102-103 F., large swelled tonsils, enlarged lymph nodes and a high white count, the temperature drops within twenty-four hours after x-ray treatment and in three or four days the patient can be discharged.

Sinuses

In 1923 Osmond[11] reported his results in treating acute and chronic infection of the antra and frontal sinuses by x-ray. Fenton and Larsell[12] published in 1932 results of experimental sinusitis in cats. Inspired by the work of Fenton and Larsell, Butler and Woolley[13] in 1934, established the rationale of the effect of x-ray on infected sinuses. They showed that the beneficial effects of x-radiation are due to the radiosensitivity of lymphoid structures of the hypertrophied membrane and the lymphocytes which, under small doses, are broken down thus liberating bacteriolysins which activate the macrophages to greater bactericidal activity. At the same time the edema of the ostia is reduced, opening them up and allowing freer drainage and aëration. Menkin[14] stressed the lymphatic blockade which takes place: " . . . following the development of any intense inflammatory reaction, a lymphatic blockade results and acts as a mechanical barrier . . . . lymphatic blockade is a basic reaction and recovery is proportionate to the potency of the local lymphatics."

Following x-ray treatment destruction of the lymphocytes can be demonstrated on the second or third day. The macrophages can later be found loaded with debris and engulfed bacteria. The edematous membrane gradually decreases in thickness and after one week fibrosis begins to appear. After several weeks the lymphocytes reappear. The fibrosis seems to be the result of the inflammatory process rather than the x-ray treatment, since there is no injury to the cilia, epithelium or cellular elements. Much larger doses of x-ray than are ordinarily used in treating sinusitis have been given by others without permanent injury to these tissues.

Rathbone[15] states that x-ray treatment of acute and chronic sinusitis in children is especially valuable because they experience very unfavorable results by the conventional otolaryngologic methods. He reports a series of 70 cases ranging in age from three months to twelve years, of which 58 were cured, 28 improved and 15 not benefited. Since some failures may be due to allergy, the diagnosis should be well worked up before starting the x-ray treatment.

Butler and Woolley[13] have reported 700 cases of infected sinuses in adults treated by x-ray. They have found that chronic infection associated with hypertrophic membrane responds best. Polyps and cysts were benefited but little, except that where the treatment was used after operation, there were fewer recurrences.

Hodges[16] reports good results in early polyposis, and poor results in old cases. Atrophic types of sinusitis responded to small weekly doses. Chronic sinusitis with thickened membranes and postoperative cases gave variable results. Our experience has shown some brilliant results in patients who have had many operations. Special mention is made of one who has had fifteen operations and had become a chronic invalid as the result of sinus disease, and who was restored to good health. This leads us to believe that x-ray treatment is advisable in all such cases. If not beneficial to a particular patient after a fair trial, it can be stopped with no harm having resulted since the doses used are small.

It is stressed that closest cooperation must exist between otolaryngologist and the radiologist in the treatment of sinusitis. The x-ray should be administered supplementary to shrinkage of the swelled nasal mucosa by astringent packs, suction, and the like, as advocated by Hollender[17] and others. Where the treatment is adapted to the patient better results will be obtained. Other physical agents, such as radiant heat, infra-red, ultraviolet, classic and short wave diathermy, may be used to advantage in combination with x-ray therapy in some patients.

Case Reports

H. N. O. Age 43. The patient had radical double maxillary sinus operation four years ago for sinus infection. In spite of the operation and much intranasal treatment he has had continuous trouble manifested as nasal and post-nasal discharge and severe frontal headaches. The headaches frequently interfere with his work as a lawyer making it impossible properly to work up his cases.

Examination showed chronic inflammation of the nasal and pharyngeal mucosa with post-nasal dripping. X-ray examination showed thickening of the mucosa on the walls of both maxillary, all ethmoid and both sphenoid sinuses.

Treatment with 200 r units at two week intervals (the patient came 500 miles for treatment) five times.

Result. — Relief followed the first treatment with no trouble since the fifth. The patient is free of pain and post-nasal dripping.

A surprisingly large number of patients suffering from chronic bronchial infection, bronchiectasis and asthma have chronic sinus infection as the primary focus. These patients are greatly benefited by x-ray treatment over the sinuses and the enlarged lymph nodes in the lung roots and the mediastinum.

C. W. Age 20. At the age of eight the patient developed sinus trouble and pneumonia following which he was troubled with asthma continuously, except with one intermission of two years, up to the present age of twenty. The asthma is bad the year round but is always made worse by a "cold." Complete test for allergy was negative.

Examination showed chronic inflammation of the nose and throat, the tonsils were out and the fossae healed with no residual tonsil tissue. X-ray examination showed both maxillary sinuses three plus opaque with marked thickening of the lining membrane of the right. The lymph nodes in both lung roots and in the mediastinum were greatly enlarged. The bronchial markings in the lower half of both lung fields were increased.

Treatment. — X-ray over the accessory nasal sinuses and mediastinum, 100 r units daily, total dose 600 r units. General body ultraviolet daily.

Result: At the end of this treatment he began sleeping all night and was able to work all day with no attacks and is still well.

Mastoids

Since the mastoid cells communicate with the nasopharynx they are subject to inflammatory disease in much the same manner as the accessory nasal sinuses. The pathology of the inflammatory process is much the same, namely, edema, closing of the outlet, pressure, necrosis of the intracellular walls and extension into surrounding structures. Since the inflammation produces thickening of the mucoperiosteum of the air cells and lymphatic block, we should expect the same favorable response to x-ray treatment. Schillinger[18] reported the therapeutic effect of x-ray in 1932, which was called to his attention by patients who had had diagnostic x-ray exposures made and who showed marked improvement within forty-eight hours. Schillinger called this, "the syndrome of favorable reaction." "The syndrome is characterized by lowered temperature, cessation of pain, absence of insomnia, lessened discharge and change in character of the discharge from purulent to mucopurulent." When the syndrome is induced by the roentgen examination it indicates the lesion is radiosensitive and that the patient will probably recover by roentgen therapy. Where roentgen therapy is used, evi-

dence of recovery, as shown on later x-ray films, lags behind evidence of clinical cure by a period of one to two months.

Otologic signs of improvement are (1) sagging disappears, (2) patency of the canal is established, (3) edema of the drum abates, (4) redness of the drum decreases, (5) tenderness is diminished, (6) feel of periosteum thinner, (7) cervical glands are no longer tender, (8) hearing improves.

In 100 cases of acute mastoiditis reported by Schillinger,[19] 64 were radiosensitive and cured by x-ray treatment, 6 were not radiosensitive, 18 were advanced surgical, and in 12 roentgen therapy was contraindicated.

The clinical and radiographic signs indicating operation are:

1. Edema over the mastoid and displacement of the auricle, indicating perforation of the cortex.
2. Transient edema in the region of the emissary vein (Griesinger sign) indicating interference of the circulation of the sigmoid sinus.
3. Torticollis indicating infection in the neck.
4. Swelling at and below the tip of the mastoid indicating perforation of the tip and gravitation of pus into the sheath of the sternomastoid muscle.
5. Failure to induce a "syndrome of favorable reaction."
6. Signs and symptoms of invasion of the bloodstream or of irritation of the dura or labyrinth.
7. Diabetes with evidence of bone destruction.
8. Cell wall or extensive destruction.
9. Progressive decalcification.
10. A forward sinus.
11. An undeveloped mastoid with cells in the squama and tegmen and evidence of infection in these cells.
12. Cholesteatomata which are neoplastic and radio-resistant.

In the average run of acute mastoiditis it would seem that about 64 per cent are suitable for x-ray therapy. The patients should be well worked up and given either radiation or surgical therapy as indicated.

Case Reports

D. S., age 11. The patient has had osteomyelitis of the right tibia, femur and hip joint beginning at the age of five. During the past two years he has been in fairly good health. The present illness began 24 hours ago as pain in the left ear, headache and stiffness of the neck. On entrance to the hospital he had a temperature of 102 F. and rigidity of the neck.

X-ray examination showed an oqaque right maxillary sinus, all cells of the left mastoid were opaque, the trabeculae showed some destruction and the petrous apex was perforated.

X-ray treatment combined with sulphanilamide was given which resulted in temperature drop to normal with disappearance of all signs of meningeal irritation in 36 hours. He remained symptom free and was discharged from the hospital on the seventh day.

Furunculosis of the nostrils and auditory canal is greatly improved by x-ray treatment, applied as in the treatment of sinusitis and mastoiditis in small fractional daily doses. Hot packs and local application of mild non-metallic antiseptic lotions are helpful.

R. S., age 28. This young man developed pain in the right ear five days before coming to us. The pain increased preventing sleep and swelling occurred in front of the ear.

Examination showed swelling of soft tissues in front of the right ear which seemed secondary to a furuncle in the anterior wall of the auditory canal just above and medial to the tragus.

Treatment. — The auditory canal was wiped out with alcohol and x-ray treatment with a dosage of 200 r given.

Result. — The same evening after the treatemnt the furuncle opened and drained. In 24 hours the swelling disappeared and in ten days the patient was discharged as well.

Acute postoperative parotitis can be stopped in twenty-four to forty-eight hours by x-ray treatment of 75-100 r units, twice daily. Where the

patient is bedfast a small portable x-ray unit may be wheeled to the bedside and the treatment given without disturbing the patient.

Erysipelas of the face is aborted in its progress by fractional doses of x-ray, twice daily. In some cases air cooled ultraviolet from the quartz mercury lamp to strong erythema but without vesication is advantageous when the disease keeps spreading in spite of x-ray teratment.

Infected granulomas of the lip and Mikulicz' cellulitis of the neck can be rapidly stopped by x-ray therapy. More treatments, given in shorter intervals, may be necessary than in sinus and mastoid disease.

Fungus disease of the mouth is favorably influenced by x-ray treatment but should be combined with iodides to physiologic effect, supplemented with local incision if areas of liquefaction occur.

Conclusion

X-ray therapy has been proved to be a valuable addition to the therapeutic methods employed in otolaryngology. The dosage usually ranges between 75 to 100 r units, once or twice daily in acute infections, once or twice weekly in chronic infections, keeping the total well below the erythema skin dose. By x-ray treatment many patients recover more quickly and many recover who have not been benefited by the usual methods.

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Discussion

Dr. John H. Gilmore (Chicago): I have enjoyed hearing Dr. Tyler's presentation very much, because for the past several years I have been particularly interested in this phase of x-ray therapy. My remarks are going to be confined essentially to generalities regarding this field. When the roentgenologist, who usually is the one who advocates this type of treatment, does so, he is met with a certain number of questions by the clinician or the otolaryngologist. The most prevalent of these questions is, What good will it do? Dr. Tyler has answered that question very adequately, but we can further refer to the literature which is quite full of good results following x-ray therapy.

The next question we are asked is, What harm will it do? So far as I know there is no clinical or experimental evidence showing that x-ray therapy as applied to any infectious process does any harm. We all know that the small amount of x-ray necessary to elicit a response where the lymphatics are concerned is not anywhere near enough to produce any damage.

We are asked, What positive indications do we have? Dr. Tyler mentioned Dr. Schillinger's so-called syndrome of favorable reaction in an acute mastoiditis. I have used this same indication regarding sinusitis. The amount of x-ray therapy given in our units that is obtained at the time of examination is very small, ranging from approximately 10 to 30 r, depending upon the technic used. If we use a Bucky technic in making the films, naturally the exposure is longer and we have a resulting larger amount of r given. In my own work it runs about 28 r for the average exposure for a complete set of sinuses.

I request the patients to note any change in their condition within the next 12 or 24 hours and to report the same to me or to the clinicians who sent the patients to me. Very frequently we note the same effect as follows regarding the syndrome of favorable reaction of the mastoid, and those cases are usually more amenable to x-ray therapy than the other ones.

What contraindications do we have to x-ray therapy in otolaryngological infections? I believe that the only contraindication to any of these infections is where surgery is indicated. Not long ago I was accused by some of my colleagues of trying to steal some of their tonsillectomies, and I answered them that they were laboring under a false presumption. I pointed out that I could obtain better results by x-ray in cases in which surgery was contraindicated than by any of the methods now extant. In summarizing this whole situation I believe that the response of any infection to x-ray therapy is based entirely upon the underlying pathologic condition of the lymphatic elements involved. Any infection which contains an abnormal amount of lymphatic cells or lymphatic blockage, or is of highly lymphoid tissue, will respond to x-ray therapy. If it does not, it won't. I believe that this problem of x-ray therapy does not belong in the hands of the roentgenologist alone but requires very close cooperation between the referring clinician, the otolaryngologist, and the radiologist, because it is the otolarynologist's first effort to determine the underlying pathology with the aid of the x-ray and then to determine whether that type of therapy is best for the patient.

Dr. R. W. Fouts (Omaha, Neb.): A rather pointed observation was made by the author of the previous paper when he commented that much of the pioneer work in the field of medicine was almost altogether on an empirical basis. This is not only accepted as true for medicine in its broadest aspect but also for radiation therapy, the main difference being that the pioneers in medicine had to educate the public upon the value of some particular therapeutic procedure, while the radiologist has had to convince his own specialty about the value of radiation therapy. In my opinion the job of the radiologist was by far the most difficult. Radiation therapy has often had to prove its value in the face of sometimes violent opposition from some members of our profession. We still see far too many cases referred for radiation therapy only after operative intervention has failed, or because they were inoperable in the first instance. The essayist exhibited slides of a very striking example of such a case.

The question immediately arises why this condition should exist. To one who has had opportunity to observe the results of radiation therapy in the class of cases discussed in this paper, there can be but two reasons: either, for economic reasons the referring physician prefers the conservative approach through methods long established, or he has not learned the modern, non-operative treatment for this class of patient. I prefer to think the latter reason is the answer. The aim of the otolaryngologist in the treatment of nasal accessory sinus disease is to establish drainage of the affected region. Who has not seen a patient that has been treated over a period of years and, perhaps, undergone several surgical operations without satisfactory relief, that has in the end responded favorably to radiation therapy.

The chronic hyperplastic mucous membrane lining these sinuses is studded with infected lymphoid tissue. This type of tissue reacts favorably and quickly to radiation, shrinking the thickened mucous membrane and providing the much sought after drainage. Acute inflammatory conditions respond equally well. Within the past five years, much has been learned about the x-ray treatment of inflammatory conditions, particularly sinusitis, and many articles have appeared on the subject. It is gratifying to note that real progress is being made toward the attainment of permanent relief of those patients who in the past have been compelled to spend so much of their time with the otolaryngologist. Radiation treatment of these conditions in the hands of an experienced radiologist is a safe and sane procedure and, if employed in the acute cases, will obviate many surgical procedures.

Professor Stéphane Leduc

1853-1939

It is with profound sorrow that we chronicle the death of Stéphane Armand Nicholas Leduc on March 5. In his death Physical Medicine has lost an eminent pioneer worker whose contributions to our domain will bear fruit for many decades if not centuries to come.

Born in Nantes on November 6, 1853, and after passing all grades of the middle school in his native city which was a prerequisite to admission to a university or its equivalent, young Leduc entered the Sorbonne to study physics and later also medicine at the medical faculty of the University of Paris. For a short while he practiced medicine in a village, but abandoned this career for that of a university teacher when the medical faculty of the University of Nantes established a chair of physics. Although he never gave up the role of a general practitioner he devoted most of his time to teaching and research and as such soon attracted the attention not only of his classes, but of many physicians and scientists who came to hear his masterly lectures and to see and evaluate his ingenious experiments, most of which were in the field of electrophysics and electrophysiology.

In a necrology by Dr. Gauducheau before the Société Française d'Electrothérapie et de Radiologie Médicale on March 28, the memory of Leduc was honored by a detailed review of his work and its influence on modern scientific medicine. Gauducheau a colleague and past President of this society, pointed out that Leduc's special study of electric currents divided itself into three important contributions; namely, (1) the physical action of electric current on living organisms, (2) the electrolytic introduction of ions in human tissues, and (3) the physical synthesis of biologic phenomena. The action of electric current on the living organisms was analyzed by studying the resistance of the human body against the continuous and later against alternating currents of high tension which he produced by electrostatic machines. Later, about 1899, he produced a new form of current, the so-called interrupted low tension current. The studies related to this subject were continued by Leduc until the last years of his life and constitute some of the basic research work in electrophysiology. Among the most important of his observations was that related to excitation of the muscles by electric currents of special wave form. It was during this research that he recognized the electrodiagnostic importance of the measurement of time duration through which the exciting current passes through the body.

By stressing the importance of the time factor he paved the way for the later research by Horweg, Weiss, Mme. Lapicque. It was this fundamental finding which helped these investigators in 1909, to develop the method of chronaxia. This work was done with muscles of cold blooded animals, a method which was later largely improved and developed in detail by Bourguignon. Leduc made every effort to define more precisely the action of the new currents on the nervous and the cerebral systems. His studies in this field are the more important because it was for a long time considered impossible to reach the centers mentioned by any method of electric excitation. He proved it possible to reproduce all the motor and sensory phenomena, and even to obtain certain psychic emotions, which convinced him that all these reactions could be produced by some synthesis of exact use of electric currents. In a series of experiments which he conducted in his courses on physical medicine he varied the size of the electrodes, the tension, the duration of the time and the sudden or progressive

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.·. EDITORIALS .·.

CRUCIAL PROBLEM OF MEDICAL SHORT WAVE INTERFERENCE WITH RADIO COMMUNICATION

Elsewhere in this issue[1] is reported the transactions of the conference on radio-medical interference at Columbia University on January 9, an occasion that gave birth to a drama of human and economic values which promises to become one of the pivotal historic events of our generation. For the first time in medical history "unofficial" cognizance has been taken of an important trend in medical practice wherein its beneficient exploitation is now challenged by the counter interests of industrial and governmental bureaus. The reason given is that the therapeutic method embodied in electro-medical equipment tends to interfere with radio reception in general and with that much publicized but still unborn prodigy of the radio amusement world, television, in particular.

This dramatic situation had its poignant moments when scientific medicine was asked to plead for the right to use this new spectacular healing force in medicine and surgery — to plead for the legal privilege to minister to the sick and the dying before a tribunal of well-intentioned but misguided lay individuals. Like mendicants, the medical profession was placed in the position of arguing for opportunity to invest its greatly diminished economic resources for purchase of highly specialized equipment in order to give over one hundred million treatments a year to those of our population for whom life and health have a far greater and eloquent value than the current radio entertainments provided or promised through commercially dictated air channels. Aside from the humiliation of being forced to plead for equal privileges before a governmentally appointed tribunal which should have remembered the protest of our Revolutionary fathers for equity in taxation and representation, the occasion was altogether a strange and sad commentary of the lack of foresight that gave rise to a situation which permitted lay interests to sit in judgment over our nation's health and sickness. The health of the nation is its wealth, and its safeguarding has been the province of a profession who have in the past been encouraged by special privileges rather than hampered by restrictions fatal to medical progress.

The situation confronting the medical profession at this moment is that restrictive legislation is contemplated in order to curtail interference by electromedical equipment of radio communication. The Federal Communications Commission under the cooperative guidance of its chief engineer, Mr. E. K. Jett, has attempted the Herculean task of balancing a highly competitive field between the forces of might and right — a situation so completely out of balance with past precedent and future development in medical and industrial progress that any immediate legislation which promises to unbalance the *status quo* will produce a hardship on the medical profession and even more so on many thousands of patients in special need of short wave treatment. The curiosity of an amusement-sated public could well be held in check until such a time when equitable and just adjudication of the situation would be attained. If priority has as much weight in this situation as it has in law, one need but remind the Commission that high fre-

quency current was introduced into medicine in 1891 by the great French electrophysiologist, d'Arsonval, and since then used without challenge or question by the medical profession for the greater good of humanity. Objections were voiced at this session by commercial interests against radio interference by medical equipment on the ground that it tended to irritate or anger certain radio fans when they were not able to catch the baritone voice of certain hairy chested masculines or the dulcet voice of certain high chested feminines broadcasting their immortal messages about that'n that. More important, as Krusen pointed out, is that these treatments are often life saving in nature. He stated that the medical consultants present understood that in the field of communication matters of life and death took precedence over all other conditions. Thus the S O S of health and life took precedence over other communications and he insisted that each interfering diathermy sound or television flicker might be as life saving as the S O S signal. If these life saving measures were to be weighed in the balance with undeveloped forms of home amusement, what a laugh the gods will have at the expense of a pleasure hunting populace.

Of all that have come before the court of the Federal Communications Commission none has presented himself with more serious mien and devoid of arrogance than the representatives of the medical profession. They pleaded their cause with dignity and eloquence and sought but equity and justice. They asked for reasonable time to adapt themselves to a new legal status wherein they could modify equipment in accordance with the greater wisdom and cooperation of the government bureau. The situation of the future apparently demands that the profession be restricted to certain wave bands and to the use of apparatus screened for treatment purposes. Whether this is best accomplished by room screening or special modifications of the transmitting circuit only time and opportunity will disclose. Above all the medical profession seeks no privilege denied others and asks only those which will permit it to render greater and more effective service to humanity.

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ADVANCES IN ELECTRODIAGNOSTICS

The fact that the methods of electrodiagnostics are today accepted as the most scientific procedures in medicine is proof that time and experience have demonstrated their value as an important guide in the differentiation of certain problems encountered in daily practice. Paradoxically, of all the procedures in physical medicine none has been accorded more universal recognition and none less emphasized by us, or one more highly regarded and utilized by those outside of our own specialized field of practice than those which deal with electrodiagnosis. If one should survey the collective curricula of modern medical teaching throughout the world one will observe the surprising extent to which electrodiagnostics is exploited in the laboratory and bedside periods as a method of special orientation in physiologic responses of body reflexes in relation to an increasing group of pathologic variants associated with every part of the living body. The medical noviti-

ate enters upon his clinical studies with the memory of the dictum that irritability is the attribute of living tissue which must react to stimuli in accordance with its special structure and state of sensitivity. From this has developed the generalization that whatever is living, reacts; whatever does not react, is dead.

Under this truism the question arises whether modern electrodiagnostics can remain adequate with the diagnostic application of the galvanic and faradic currents for affections of the neuromuscular system. This has been the practice up to recent years, but since then electrodiagnostics has been developed and extended to include virtually the entire domain of the functions of the entire human body. Electrodiagnostics as applicable today is therefore inconceivable without utilization of the vast research achieved in the field of physiology. It is only by a thorough appreciation of modern physiology that one can harmonize the differences between the results obtained in the experimental laboratory and those in clinical practice. To this should be added that adequate evaluation of both experimental and clinical responses to electrodiagnostic methods presupposes also a thorough familiarity with electrophysics, and for this no class of physicians is better prepared than those who have taken a deep interest in scientific physical medicine.

While it is commonly accepted that a low voltage current produces definite reactions in the peripheral nervous system and its related musculature, it must be borne in mind that this field of examination has in recent years been extended to include other important systems and organs, such for example as the glands of inner secretion, the organs of hearing and vision and especially the still obscure functions of the vegetative nervous system. While with the older and simpler currents the art of diagnosis was of necessity restricted in scope, there have been developed refinements both in apparatus and diagnostic technics which have extended the field to a degree which only a few decades ago could not have been visualized and realized. We need only think of the equipment needed for chronaxia and the many clinical observations with it which today permit almost precise diagnoses in many obscure affections to at once appreciate the great strides that have been made in the field under consideration.

Today modern electrodiagnostics is no longer limited to a determination of the mere presence of a reaction or its degeneration but demands that there be an establishment of the time element expressed in fractions of a second which are of utmost significance for the recognition of conditions that were not recognizable with the older means. Even the great advances made by Pflüger's experiments which resulted in his law of contraction, the phenomena of polarization and the theory of excitability advanced by Nernst, and the utilization of condenser discharges are only a part of the progress recorded by modern researches. All these may be regarded as a means toward attainment without being an end as such. If all these advances would have purely theoretic interest, clinicians could afford to leave their study to laboratory workers, but as a matter of fact all of them and especially the precise application of Lapicque's[1-2] current have already been shown to possess very valuable implications in actual clinical work.

It is probably known to most students of physical medicine that, as Bourguignon[3] has shown, each muscle of the body has its own peculiar chronaxia or reaction time. On this basic concept studies have been made to determine normal chronaxia values which in turn proved a most reliable means of differentiating these from pathologic deviations and thereby made it possible to recognize the underlying processes. Furthermore, Bourguignon has shown that muscle agonists which produce motion do not possess the same chronaxia as their antagonists, with a difference at a ratio of 1 to 3.

This particular knowledge even with reference to certain deviations in some muscle groups have been charted and tabulated so that every diagnostician has reliable data for the differentiation of the normal from the abnorml. Thus it is today possible by this method to determine muscular fatigue, stasis of the circulation, disturbances in metabolism, as well as changes in chronaxia produced by irritation of the sympathetic nervous system in the areas it controls.

An example of the value of chronaxia is had in those cases of anterior poliomyelitis which manifest themselves with a degeneration of reaction. It is precisely in these cases that one can observe pronounced changes of irritability of the neuromuscular system, which are characterized by modification of the chronaxia values, so that one can localize by this method the changes in the cells of the anterior horn. A similar observation is made possible with changes in the spinal roots when they cause degeneration of the muscle fibers innervated by them. The newer methods facilitate today more detailed and more precise diagnostic studies of various forms of polyneuritis, and while the dietetic, toxic and etiologic factors including the avitaminoses are by no means to be neglected, repeated electrical tests provide the clinician with invaluable information regarding the course of this type of affection and thereby the ability to determine their prognosis. Better diagnoses and prognoses are today rendered possible by these methods in many lesions of the nervous system due to trauma, in paralysis, and for the recognition of any regenerative process that may take place.

Modern electrodiagnostics has celebrated triumphs in diseases of the central nervous system. By means of chronaximetry it is often possible to determine lesions of the pyramidal tract, of the cerebellum, tabes dorsalis, and amyotrophic lateral sclerosis. It would appear then, that systematic application of the discussed methods will prove of value also in the evaluation of a number of so-called muscular diseases, such as progressive muscular atrophy, Thomsen's disease (congenital myotonia), and myasthenia gravis. What has been said holds good also for certain familial affections such as hereditary ataxia, tetany, spasmophilia, rickets, Recklinghausen's diseases (fibrocystic disease of the bone) and Paget's bone disease. While adequate data are not yet available, studies have been undertaken with regard to arteritis obliterans which already hold out the hope that much information will become available in the not too distant future. Here, then, is a frequently seen affection which should afford all engaged in its treatment to undertake repeated examinations with chronaxia and other methods in order to shed greater light on the involved problem.

These newer advances have also great usefulness in otology and ophthalmology. While specialists have for some time appreciated the diagnostic value of electrical in addition to the conventional tests, chronaxia and other electrical stimuli facilitate today positive determinations of qualitative changes in the vestibular apparatus and of the acoustic nerve. Thus it is possible better to localize disturbances of the cochleo-vestibular system with particular reference to the nerve centers. As an example, in neuritis of the eighth nerve the chronaxia of the vestibule is greater than that of the labyrinth. In the domain of ophthalmology chronaxia has a definite and most valuable place for diagnosis when by reason of dimness the eye-ground cannot be properly seen by ophthalmoscopy, as happens in certain types of ocular hemorrhage, glaucoma or cataract. Even in cases of total amaurosis and the early stages of optic atrophy, detchment of the retina and chorioiditis, has chronaxia enabled the establishment of early diagnosis when they were not attainable by the usual diagnostic methods.

In this respect we need but be reminded of the progress made in the

diagnosis of cardiac lesions by electrocardiography, oscillography and electromyography in muscular disturbances, to realize not only the modern trend in electrodiagnosis but to appreciate the contribution made by electrophysics to scientific medicine. This trend has already found a field also in psychiatry, since it is now possible to determine certain reflexes by psychic stimuli. In the form of tests for disturbances of sensitivity, psychic reflexes have found a field in conditions of mental depression, in post-encephalitic Parkinson's disease, in exophthalmic goitre, enophthalmia and in cortical lesions. These sensory tests are carried out with special galvanic currents with non-polarized electrodes which under psychic stimuli produce a definite effect on the current as shown by a sensitive galvanometer, which is easily explainable by a rapid reduction of the electric resistance of the subjected tissues.

From the limited presentation of these data which are far from being all-inclusive, it is evident that modern electrodiagnostics offers a field of special endeavor of great clinical importance to such workers grounded in the fundamentals of electrophysics and physiology who will apply themselves according to the present day knowledge in this field of diagnosis. The literature concerned with these problems is rich but too widely dispersed for systematic study, and it is for this reason that the profession owes a debt to Neoussikine and Abramowitsch[4] who have collated the entire subject in one monograph reviewed elsewhere in this issue. Physical therapy should not permit the opportunity to pass without seriously undertaking with its better facilities the development of so fruitful a field as modern electrodiagnostics and thereby render service of incalculable value to the entire field of clinical medicine.

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HOTEL RESERVATIONS FOR ANNUAL CONVENTION

Due to the World's Fair, desirable hotel accommodations in New York City will be difficult to secure unless reservations are made early. The Congress will make every effort to house you and your family while you are attending the convention, but urges that you send in your reservations now. The Hotel Pennsylvania is desirous of accommodating as many Congress visitors as it possibly can, but makes no assurances for last minute registrants. *Please have this in mind and write today either to the central office of the Congress, or direct to Hotel Pennsylvania, New York.* List your requirements and the matter will have prompt attention.

INSTRUCTION SEMINAR PRECEDING 18TH ANNUAL SESSION

The popularity of and continued demand for the instruction seminar conducted last year in Chicago, has led the officers of the Congress to repeat the session this year. The course will stress the practical and clinical side of Physical Medicine, and will be held at the Hotel Pennsylvania, August 30, 31, September 1 and 2. Half of each day will be devoted to hospital clinics. Late afternoon periods will be given over to small group conferences. Didactic lectures will occupy the early afternoon hours. The combination of these methods of instruction avails the physician and technicians the most ideal procedure of graduate teaching. The clinics in particular should prove of inestimable value as they will emphasize those aspects of physical therapy that are in daily demand by the general practitioner and the most promising in value. If you have not already applied for this seminar, you are urged to do so at once, for yourself and for your technician. The group will be limited to one hundred. The faculty has been selected from the outstanding workers in the specialty. Write for application form to American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago.

SCIENTIFIC EXHIBITS FOR CONGRESS, NEW YORK SESSION

During the past few years the scientific exhibits of the fall session of the Congress have become a regular feature. Physicians and others interested in the field of physical therapy have in the past complimented the Exhibit Committee for the excellent display of scientific material. Each year an effort is made to improve on the preceding one. This year, in particular, during the World's Fair, physicians and others attending the Congress convention will look forward to the unusual developments that have taken place in the therapeutic, diagnostic and biologic branches of Physical Medicine. The Committee extends an invitation to individuals, hospitals, laboratories and teaching institutions who have instructive and interesting scientific material to exhibit in physical therapy or its allied branches to apply early for space. While we are equipped to handle a large number of exhibits, requests for space are being made right along. It is therefore quite important that applications be forwarded immediately to the local committee or direct to the central office of the Congress. All the exhibits will be held on the Ball Room floor of the Hotel Pennsylvania, New York City, September 5 to 8, 1939. For further particulars address Dr. Richard Kovács, 2 East 88th Street, New York, or Executive Secretary, American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago, Illinois.

Professor Stéphane Leduc

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variation of the current intensity, and succeeded by such means in producing in his experimental courses phases of epileptic crisis with its characteristic three stages of tonic, clonic and stertor states.

By means of special electric impulses he demonstrated the induction of electric sleep combined with complete anaesthesia, which could be controlled from two to even eight hours without any damage or danger to the animals. He further showed that by increasing the voltage he was able to stop the respiration and later the heart beat which was tantamount to physiologic death of the animal. Subjects in this state, however, could be revised by

passing the same current in rhythmic impulses or waves which simulated a respiratory rhythm, provided that the previous treatment did not last too long. This study was the first of its kind to demonstrate that real artificial resuscitation could be achieved by electric means.

The problem which formed his most spectacular study was the introduction of ions in the living organism. Every student of electrophysiology remembers his famous experiments of connecting two rabbits in series in the circuit of a direct current. One of these animals was coupled to the anode the electrode of which was saturated with an extremely low percentage of strychnine sulfate. The cathode electrode carried a low saturation of sodium chloride in contact with the second animal. Only the first animal in connection with the anode died. The second survived. He also studied the possibilities and peculiarities of various solutions in iontophoresis, especially those of iodine and zinc.

Leduc early realized the importance of theoretic investigations in biology, and a large part of his efforts was concentrated on synthetic biology. As early as 1901 he tried to reproduce by pure physical experiments the various manifestations of life, such as structure, cellular growth, division, and the like. Well known is one of his experiments in which he succeeded in showing that the forces in electrolytic solutions were associated with variation of osmotic pressure due to concentration of the solution which reproduced morphologically a very simple model of existing living cellular organisms.

To us his life, apart from its human aspect, is one of achievement for our cause. Although he never was really systematic, he outlined his work in definite directions. These briefly may be described as research on the physical effects of electric currents on the human organism, on ionization of human tissues, and on the synthetic creation of biologic phenomena. Of these the recognition that ions of certain electrolytes can be electrically transmitted to tissues at some depth is from our point of view outstanding, because it has added a valuable method to physical therapy. Leduc's life was complete in its intensive occupation and preoccupation, so that at the end of 86 years he is honored and mourned as a patriot, soldier and scientist of a sister Republic, and as a universal citizen of science. France accorded him the Legion of Honor for services in the World War and American science awarded him the Gold Key of Merit for outstanding services rendered humanity.

TECHNICIAN EXAMINATION

Announcement is made of an examination for Junior and Senior groups in New York City, June 19 and 20, at the Hospital for Ruptured and Crippled. All applications must be in the office of the Registry not later than June 5. For application form and information address all communications to

AMERICAN REGISTRY OF PHYSICAL THERAPY TECHNICIANS

30 North Michigan Avenue

CHICAGO

SCIENCE, NEWS, COMMENTS

Famous French City Honors Dr. Blech

It is with distinct pleasure that we record the news of an honor, as rare as it is unusual, bestowed upon our editorial coworker, Dr. Gustavus M. Blech, of Chicago. Our distinguished coileague, as is known to most of us, has on several occasions rendered our country self-sacrificing services as a military surgeon. Specifically his military career brought him to many fronts in the Spanish-American War, as a volunteer surgeon in the Russo-Japanese War and in France during the World War, where he was promoted until made chief of Base Hospital 208, near Bordeaux, probably the largest institution of its kind. The richness of this experience might be said to have been an avocation outlet to his life's work in surgery, to which he has contributed timely, progressive and thought-provoking labors. To cite two examples, his recent work on clinical electrosurgery is today regarded as distinctive in its exposition as was his book on medico-military tactics. Whether his literary labors had to do with his most recent of the many decorations and academic honors that have fallen to him in his Spartan-like labors is but to infer that the most literary-conscious city of France was not without knowledge or sympathy with such pursuits. Whether this was the fulcrum that reminded the ancient city of its debt for special services rendered it by General Blech is not as important as is the fact that after a lapse of twenty years the intellectual French center, the birthplace of the encyclopedist and philosopher Diderot, accorded him the uncommon distinction of an Honorary Citizen of the famous City of Langres. Parenthetically it may be interesting to recall that this same city about six years ago awarded Dr. Blech to use its ancient coat of arms as his own. This is significant that his additional labors have been recognized by that municipality.

Dr. Saidman of Paris Visits America

Dr. Jean Saidman of Paris, eminent actinologist and Physician-in-Chief of the Solarium at AIX-les-BAINS, President of the French Society of Photobiology and Heliotherapy, is touring the United States on a scientific mission under the auspices of the French Government. Dr. Saidman who was a guest speaker at the recent meeting of the Eastern Section of the Congress where he presented a most instructive contribution to the subject of physical medicine with special reference to newer methods in heliotherapy, has included in his itinerary the city of Chicago after an extensive journey to the East and South of the United States. This visit proved of great benefit to all physicians who had the opportunity of meeting with this distinguished specialist who imparted many new data to them on problems dealing with photobiology and phototherapy which in our country have in recent years received inadequate attention. The ARCHIVES welcomed Dr. Saidman to Chicago with that cordial deference due to one of such high reputation in his own land, and extended him the opportunity to also investigate our labors and concerned institutions. It is hoped that Dr. Saidman will carry with him to his native country a realization of the serious efforts made and to be made by American Physical Therapy. He has our best wishes added to our great admiration for him both as a scientist and as a man.

Pacific Physical Therapy Association

The regular April meeting of the Pacific Physical Therapy Association was held April 26, in Los Angeles County Medical Association Building, and the following program was presented:

1. Present Status of the Use of Physical Measures in the Treatment of Skin Diseases, *Samuel Ayres, Jr.*, M.D.
2. Infra-Red Photography (a) Of the Maxillary Sinuses, *Roy A. Falconer*, M.D.; (b) In Medical Conditions, *Charles B. Coggin*, M.D.

This will be the last meeting until the Western Section of the American Congress, June 14th and 15th.

Chemist Wins Garvan Medal for Ultraviolet Research

For her long continued and intricate investigations in the far ultraviolet wavelengths, Dr. Emma P. Carr, head of the chemistry department at Mt. Holyoke College, will be the first recipient of the Francis P. Garvan gold medal, established to honor outstanding women chemists.

Dean Frank C. Whitmore of Pennsylvania State College and president-elect of the American Chemical Society meeting here made the announcement. Actual presentation of the medal, named in honor of the president of the Chemical Foundation, will not be made until the spring meeting of the Society.

Dr. Carr's spectrographic studies are in the far ultraviolet region of the spectrum, where the ultraviolet shades off into the x-ray region. All the measurements are made in special vacuum spectrographic apparatus which was provided through funds of the National Research Council.

The Rockefeller Foundation granted financial aid which permitted Dr. Carr to study the absorption

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THE STUDENT'S LIBRARY

ELEKTRODIAGNOSTIK. Von Dr. *B. Neoussikine* und Dr. *D. Abramowitsch*, Tel Aviv, Palestine. Cloth. Pp. 242 with 30 illustrations. Price, Swiss Fr. 12. Berne, Switzerland: Hans Huber, 1939.

Electrodiagnostics today occupies the interesting position of having an increasing number of our specialties lean upon its findings for supportive or confirmatory evidence. This undoubtedly is due to the increasing appreciation of the value of electromedical equipment by the profession and its more intelligent application in practice. At no time in recent years has the impressive usefulness of electrodiagnosis been more clearly indicated and more detailedly expatiated than has been accomplished in the text under consideration. Especially interesting is the fact that in spite of economic and geographic handicaps, the authors have managed to contribute one of the most scholarly monographs on the fundamentals and progress of electrodiagnosis seen in any language. The pathos of the quips of fate is here illustrated by a story stranger than fiction — a story of an intensive collaboration of individuals at Tel Aviv on a work written in German and published in Switzerland about a diagnostic procedure that was born and cradled by French science and now universally recognized as one of the most orthodox methods sanctioned by a profession that knows only the boundaries of service to humanity. Perusal of this work is therefore certain to revise complacent impressions that electrodiagnostics play anything but a minor role in modern medicine, and is furthermore certain to develop justifiable enthusiasms for the increasing information now possible to elicit from data that are both extensive and critically organized. Though divided into six major sections, each of these is properly organized into chapters and suitable subheadings, which render study a progressively interesting and informative pursuit. Stylistically the exposition suggests the brusque, precise and concise quality which leans more upon the tersely descriptive fact than the padding by colorful circumlocution. The authors aim at the single objective of demonstrating a method and its advances that holds out promise of increasing our ability to determine the progress, status, prognosis of a large variety of affections which have been found to react to the galvanic, faradic, or their modified currents, and especially to elective condenser discharges associated with the term chronaxia. The introductory chapter paints a concise picture of the relationship of living material, its irritable state and the influence of electric stimulation thereon, and provides in the space of three pages the most concentrated exposition on the problems of electrodiagnosis. The succeeding sections deal with the physical and physiologic nature of electric currents, their methods of application and response of various types of tissues. Nearly two-thirds of the book is devoted to the methods of electric testing by galvanic, faradic and chronaxia currents on different stages and types of diseased tissue. This field is so richly expatiated that it opens up a wide terrain of new possibilities by electrodiagnosis unknown but useful to the average physician. Undoubtedly this monograph will have an important influence on the future progress and practice of electrodiagnostics, and were it not for the exception of the omission of a much needed bibliography and an index, this work would readily be considered as the perfect contribution on the subject. It is hoped that a future edition will correct this omission and that an ambitious translator will bring this work into the English language for the benefit of those unable to read it in the original.

ONDES ELECTROMAGNÉTIQUES EN MÉDECINE: LA D'ARSONVALISATION (Electromagnetic Waves in Medicine: D'Arsonvalization). By Docteur *Charles Bardon*, de la Faculté de Médecine de Paris, Interne de l'Hôpital de l'Institut Pasteur. Paper. Pp. 132 with 20 illustrations. Paris: Vigot Frères, 1939.

Writers in the domain of science today are more or less satisfied to build their literary structure with the bricks of facts and prefer such solidity to the elasticity of esthetic expression. This small volume teems with facts, facts and more facts, but fortunately for the reader these are combined by the beauty of lucid rhetoric into a thesis that makes the discourse as vivid and fascinating as romance in its most attractive form. The contents read more like a story than a biographic monograph, of a young scientist by name of Arsène d'Arsonval, who in the closing two decades of the last century demonstrated an inventive genius by contributions to the then unknown field of electrophysiology which have since become recognized as fundamental and far reaching in importance. Today d'Arsonval looms in gigantic proportions as the legendary figure who discovered medical high frequency current. The author, a nephew of this eminent scientist, draws back the curtain of past events and in vivid descriptive chapters conveys the reader in chronologic sequence through the scenes of d'Arsonval's labors. As a student and laboratory assistant of Claude Bernard he was taught and became inspired with the experimental method of research elaborated by this renowned physiologist. From 1882 to 1891 d'Arsonval experimented with methods of producing electric waves which culminated in his discovery of the sinusoidal and high frequency currents. His studies of nerve excitability were the basis for many of our more recent electrical contributions in medicine; namely, the work of Lapicque and Bourguignon in the field of chronaxia and chronaximetry, and the like. His

synthesis of electric currents in physiologic processes initiated the d'Arsonval galvanometer which is not only the model upon which all and succeeding instruments are based, but is responsible for the more delicate types now utilized under the name of electrocardiographs. The splendor of d'Arsonval's achievements at times is depicted in incisive but somber colors, especially in that part where the biographer describes the historical events succeeding d'Arsonval's legitimate claims to the discovery of high frequency current. Soon this was contested by Tesla and the latter's claims by Thompson, which have so beclouded the issue that even today we see unjustified partisanship in the matter of priority for this discovery. Bardon has rendered medicine a great service by once and for all time clearing up this priority of d'Arsonval in this domain, beyond dispute of even those with chauvinistic inclinations. In broad strokes the author describes the mechanical, physiologic and clinical research of this scientist which was responsible for the acceptance of diathermotherapy as a unit in scientific practice and its evolution into short wave therapy. As already hinted above this biographic work is easy and interesting reading because it presents facts in a direct and lucid style. To students of this subject it has an especial appeal because it is an inspirational biography of the father of modern electrotherapy. While not as profound nor as meticulously edited as that of the now famous work of Chauvois, it presents in brief yet broad strokes the life and accomplishments of one of the greatest scientists of modern times.

THE PHYSIOLOGY OF EXERCISE. A TEXT BOOK FOR STUDENTS OF PHYSICAL EDUCATION. By *James Huff McCurdy*, A.M., M.D., M.P.E., Director of Physical Education, Springfield College, Springfield, Mass., 1895-1935, etc., Research Worker (Herbert L. Pratt Research Fellowship), 1935, and *Leonard A. Larson*, B.A., B.P.E., M.Ed., Ph.D., Professor of Health and Physical Education, Springfield College, Springfield, Mass. Third Edition, Revised and Enlarged. Pp. 349, Illustrated. Cloth. Price, $3.75. Philadelphia: Lea & Febiger, 1939.

The present edition has been thoroughly revised, and presents the findings of research work and clinical studies on the physiology of exercise during recent years. A chapter on exercise for individuals over forty years of age and another on exercise for women have been added. The first part considers the general effects of exercise upon bodily functions. It discusses the value of physical efficiency and how it can be attained; general types of exercises; circulation, respiration, and the blood in relation to exercise; and the neuromuscular mechanism. The second part deals with the effects of special types of exercise upon bodily function. There are chapters on gymnastics and athletics for men, adolescent and adult; physical education for women; exercises for the middle aged; exercises at unusual pressures, such as aviation and mountain climbing; and aquatic exercises. The methods of indicating efficiency of bodily functions are discussed in the third part. The authors were aided in this revision by many leaders in this field, and they have carefully selected the best authenticated studies on the subject. Where the authors and other workers disagree in their findings, an attempt has been made to evaluate the results. As exercise is one of the most important agents used in physical therapy, this book should be read by everyone interested in this branch of medicine.

A TEXT-BOOK OF X-RAY DIAGNOSIS. By British Authors. Edited by *S. Cochrane Shanks*, M.D., Physician, With Charge of Out-Patient Departments of Radiology and Electro-Therapy, Charing Cross Hospital; Radiologist, The Prince of Wales' General Hospital, etc.; *Peter Kerley*, M.D., D.M.R.E., Physician to the X-Ray Department, Westminster Hospital; Radiologist, Royal Chest Hospital ,etc.; and *E. W. Twining*, M.R.C.S., L.R.C.P., D.M.R.E., Radiologist, Royal Infirmary, Manchester; Radiologist, Christie Hospital; Late Hunterian Professor, Royal College of Surgeons, etc. In Three Volumes. Volumes I and II. Cloth. Price, 50s; 42s. Pp. 591, with 398 illustrations; 458, with 307 illustrations. London: H. K. Lewis & Company, Ltd., 1938.

British Medicine may well be proud of its brilliant pioneer work in the field of roentgenology, and seldom has this been more eloquently attested than by the two volumes under consideration. These are the first of a series of three volumes on x-ray diagnosis intended to review and depict in shadowy black and white form the various sections of the body. It has been the objective of the editors and their eighteen collaborators to provide in textbook form a comprehensive survey of the modern advantages of x-ray in medical diagnosis. In harmony with this design the discussions are limited to essential details of technic and purposely avoid matters pertaining to the physics or mechanics associated with x-ray practice. Throughout these volumes emphasis has been laid on the common lesions met with in roentgenologic practice with the intention of making this contribution more representative of the problems met in practice than specialistic in aim. The broad scale of this undertaking is strikingly supported not only by the careful selection of collaborators but by the splendid cooperation and generous support of the publisher. The two volumes are printed on highly glossed paper which not only permits clarity of the printed word but shows to great advantage the suggestive three dimensional depth effect of the 705 illustrations in the text. The publishers are to be congratulated on the elegant, elaborate and luxurious mechanical format which has made more possible clearly to appreciate the scientific value of this extensive efforts by our British colleagues. Volume 1 is divided into three large sections, and deals with the cardiovascular, respiratory and urinary systems. The pathologic conditions encountered in these fields are exhaustively illustrated and detailedly discussed. The material in volume 2 is equally rich in illustrative data and deals with diseases of the alimentary tract. The subject matter is grouped into five suitable parts and these into several sections. Parts 4 and 5 devote special consideration to the female genital tract and discuss x-ray in gynecology and special

advantages of x-ray technic and diagnosis in obstetrics. Appended to the end of each volume is a fairly comprehensive bibliography and a highly detailed index. This work as a whole merits praise for the clarity and terseness of the exposition and the richness of the beautiful illustrations. It has been written with an eye toward the practical side of x-ray diagnosis and in a style that arouses admiration for its artistic balance.

EXPERIENCE IN THE MANAGEMENT OF FRACTURES AND DISLOCATIONS (Based on an Analysis of 4,390 Cases). By the Staff of the Fracture Service, Massachusetts General Hospital, Boston. Under the General Editorship of *Philip D. Wilson*, M.D., Surgeon-in-Chief, Hospital for Ruptured and Crippled Children, New York; Clinical Professor of Orthopaedic Surgery, College of Physicians and Surgeons, Columbia University; Formerly Associate Chief, Fracture Service, Massachusetts General Hospital. Cloth. Price, $15.00. Pp. 1036 with 1419 illustrations. Philadelphia, Montreal, London: J. B. Lippincott Co., 1938.

The material in this volume differs from other books on fractures in that it is based upon the actual study of cases and an analysis of the results of treatment. The criticism has often been advanced that too many treatises on fractures present a great variety of appliances and methods for the management of each type of fracture, and even discuss the treatment of abstract types of injury. The physician who consults such a book often becomes bewildered with the encyclopedic material presented. This work avoids many of these objections. There are twenty-two collaborators who reviewed the various fractures of the body. Under each fracture is given a consideration of the anatomy of the part, a discussion of the material studied, diagnosis, treatment, and summary of the cases treated. Under the last subject, for instance in the study of fractures of the lower end of the radius, the author discusses the closed reduction group, the effect of the interval between injury and reduction; effect of the extent of injury; imperfect reduction; maintenance of reduction; duration of splinting; attitude of patient; cases treated by operation; compound fractures; separation of the lower radial epiphysis; growth disturbance; and end results. This is followed by 27 pages of case histories with sketches of the x-ray films in many of the reports. This volume should be of value also to physicians interested in physical therapy, because it gives the time to start motion and exercise following immobilization. The book is highly recommended.

DISEASES OF THE SKIN FOR PRACTITIONERS AND STUDENTS. By *George Clinton Andrews*, A.B., M.D., Associate Professor of Dermatology, College of Physicians and Surgeons, Columbia University; Chief of Clinic, Department of Dermatology, Vanderbilt Clinic; Fellow of the American Medical Association, of the American College of Physicians, and of the New York Academy of Medicine. Second Edition. Entirely Reset. Cloth. Pp. 899 with 938 illustrations. Price, $10.00 net. Philadelphia and London: W. B. Saunders Company, 1938.

The praise showered on this book in recent years will re-echo in greater volume when the virtues of this second edition are told. Both in quality and quantity of material the present edition offers appreciable advantages over its predecessor. It is from an artistic and literary point of view not only an advance over its past efforts but contains that indefinable and all inclusive quality that makes it stand out as the dependable, reliable and authoritative voice in dermatology. It has the three virtues of clear print, clear diction, and clear illustrations as the immediate recommendations to a scientific exposition that emanates from a source both authoritative and rich in experience in this domain. Andrews has evaluated the great advances made in dermatology and the introduction of these has made it necessary to revise practically every page of the text. Accordingly, more than 75 new diseases have been added and new chapters included on dermatoses due to filterable viruses, vitamin deficiencies, and cutaneous infiltrations with products of metabolism. Other chapters have been completely rewritten, obsolete treatment excluded and newer ones emphasized. These include the chapters on x-rays, eczema, syphilis, lichen planus, fungus and tropical diseases. One also notes that special information has been included under the subject of newer remedies and prescriptions, discussion of allergy, sensitization tests, desensitization and dermatologic surgery, as well as over 40 new histologic microphotographs and drawings. From what has been said it is clear that this edition is representative of not only the best traditions of this reputable firm of publishers but also of the painstaking efforts of a well known teacher in diseases of the skin. The book is highly recommended.

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spectra of what chemists call the unsaturated hydrocarbons.

Her researches have led to important contributions to the knowledge of molecules used by the petroleum chemists.—*Science News Letter.*

Daily Skipping Advised for Foot Strengthening

Physicians, especially those specializing in orthopedics, have talked themselves hoarse, it would seem, on the foot-deforming effects of pointed-toed, high heeled shoes. A look into the shop windows must be truly discouraging. Yet they persist in their efforts.

The essentials of a satisfactory shoe are described by one authority as follows: It must grip the heel firmly and have a bar or tie which fits over and grips the instep. The heel should not be higher than one or one and one-half inches. The fore part or vamp should be a little more anatomically correct than the foot, allowing room for the toes to move about.

Such a shoe allows the joints of the foot to move actively in stepping forward, the transverse arch can flatten and reform normally when weight is put on the foot, and the activity of the muscles is preserved.

A more psychological and possibly more successful approach to the problems of getting people to wear correct shoes is suggested by another medical man. He suggests teaching the rising generation to "admire as elegant" the anatomically perfect foot. This foot has a straight inner border and mobile arches. When such a foot becomes fashionable, it is suggested, manufacturers will make shoes to fit the feet.

Daily skipping for ten or fifteen minutes either barefoot or in "gym" shoes is suggested as a method for strengthening the growing feet of children. Both this and the suggestion for running barefoot on the grass or playground seem likely to be one of the more popular pieces of health or medical advice.

Interestingly enough, the German doctor who recommends making these exercises a regular part of the school curriculum prefers running sports to maneuvers which involve prolonged route marches and long periods of standing. — *Science News Letter.*

Vitamin C May Be Formed From Fatty Substance

Vitamin C, the substance in fresh fruits and vegetables which prevents and cures scurvy, belongs to the sugar and starch group of chemicals, but some detective work on its origins now shows that it is probably formed by plants and lower animals from a fatty substance.

Details of the investigation which gives new information on how this vitamin that scientists can produce in the laboratory is formed in life and on the novel chemical idea of a fatty substance like a lipid playing a part in the building up of a sugar are reported by Drs. Rade R. Musulin, Robert H. Tully, III, Herbert E. Longenecker and Charles Glen King (*Science*, December 9).—*Science News Letter.*

Meetings of Physical Therapy Organizations

In this permanent column will be published information about meetings, election of officers, etc., of physical therapy organizations. New data should be sent promptly to the office of the Secretary, 2 E. 88th St., New York.

American Congress of Physical Therapy 18th Annual Session, Hotel Pennsylvania, New York; September 5, 6, 7, 8, 1939; Dr. Richard Kovács, 2 East 88th Street, New York, Secretary.

Special Instruction Seminar, August 30, 31, September 1, 2, 1939, preceding 18th Annual Session, American Congress of Physical Therapy, Hotel Pennsylvania, New York. For detailed information see announcements elsewhere this issue.

Western Section, American Congress of Physical Therapy, under the auspices of the Pacific Physical Therapy Association, 7th Annual Session, June 14 and 15, 1939, Los Angeles County Medical Association Building, Los Angeles, G. Mosser Taylor, M.D., Secretary, 312 N. Boyle Avenue, Los Angeles. (See announcement program elsewhere this issue.)

American Physiotherapy Association; 18th Annual Convention, Hotel Cosmopolitan, Denver, Colorado, June 25, 26, 27, 28, 29, 30, 1939; Mrs. Eloise T. Landis, 2065 Adelbert Rd., Cleveland, O., Secretary.

Pennsylvania Physical Therapy Association; meetings at the Philadelphia County Medical Society Building, third Thursdays from September to June; Dr. Arno L. Zack, 216 East Broad Street, Bethlehem, Pa., Secretary.

New England Physical Therapy Society; meetings at Hotel Kenmore, Boston on third Wednesdays from October to June; Dr. William McFee, 41 Bay State Road, Boston, Mass., Secretary.

Pacific Physical Therapy Association; meetings at Los Angeles County Medical Association Building, fourth Wednesday. Clarence W. Dail, M.D., Sec'y., Treas., Loma Linda, Calif.

New York Physical Therapy Society; meetings on first Wednesday from October to May; Dr. Madge C. L. McGuinness, 1211 Madison Avenue, New York, Secretary.

Kings County Medical Society, Physical Therapy Section; meetings at 1313 Bedford Avenue, Brooklyn, bi-monthly on second Thursdays; Dr. H. T. Zankel, 5 St. Paul's Place, Brooklyn, Secretary.

INTERNATIONAL ABSTRACTS

Treatment With Hertzian Waves. W. A. G. van Everdingen.

Acta radiol. **19**:565 (Dec.) 1938.

The author gives a theoretical outlook on Debye's dipole theory. A description is given of the apparatus used by the author to test the conditions for the validity of the theory for animal tissue at a wavelength of 16-18 cm. There is evidence that one of these conditions is nearly fulfilled. A marked difference was found between normal and the tissue of some forms of experimental tar cancer. The results are given of radiation of mice with tar cancer with a wavelength of about 16 cm. A remarkable reduction of these tumors is observed when the largest dose bearable is given. In one case a small tumor disappeared totally. The life of the animals was lengthened for several months in comparison with the longest living test animals. The author concludes that there is value in the uses of still higher frequencies than that which are at present employed.

Results of Short Wave Therapy Treatment in Gynecology. A. Guthmann and Maria Reitz.

Strahlentherapie **60**:582 (April) 1938.

The results of some clinical research done with human subjects demonstrate that the wavelengths between 5.5 and 6.5 meters are most effective when applied to treatments in gynecology. It should be noted that the subcutaneous tissue is heated about three times as much as the muscular tissue. According to clinical observation it is not very probable that the action of short waves are only due to the heating effect but is very likely a consequent of some other effects responsible for the clinical results.

Effect of Induced Hyperpyrexia on Urea Clearance of Rheumatic Patients. Lee E. Farr, and Johannes K. Moen.

J. Med. Sci. **197**:53 (Jan.) 1939.

No significant direct relationship between fever and the urea clearance has been noted in patients with Bright's disease. The mechanism producing the lowered clearance was presumably a retarded renal blood flow. Possible causes of the retarded renal circulation may have been either deflection of blood from the kidneys to the hyperemic skin, or occurrence of some desiccation despite the precautions taken to prevent it. The decrease in renal function was not serious in any of the patients, and was transitory. The fact that a definite decrease occurred, however, emphasized the desirability of combating desiccation during the febrile treatment and of applying them with caution to patients with damaged kidneys, until their effects in such patients have been studied.

Urea clearance tests were done on 7 patients before, during and after hyperpyrexia was artificially induced. The average urea clearance was 61.7 per cent of normal during the period when the fever was mounting, and 75 per cent when the fever was maintained at its maximum. The control clearances on these patients averaged 105 per cent of normal. The data indicate the desirability of combating dehydration during fever therapy.

Electrolysis for Superfluous Hair.

An increasing number of electrolytic instruments designed to remove hair, moles and warts are appearing on the market. There is a growing tendency for laymen, unqualified by experience and training, to undertake the use of such apparatus. The electrolytic instruments may be found in beauty shops and in offices conducted by self-designated electrologists, hair specialists, lay dermatologists, depilatory experts and the like. Because of the seeming simplicity of the processes, people are often misled into believing that they are quite safe with these lay operators. Actually there are a number of reasons why such safety is not assured. First, untrained operators are apt to have little knowledge of aseptic technic. The importance of proper sterilization of the patient's skin, the operator's hands and arms and the needle holders and needles, as well as the proper precautions to avoid infections, are largely unknown to or may be disregarded by these technicians. Infection may be mild, such as a small pustule, or may result in abscess formation. Erysipelas has been known to develop around one of the infected regions. If the infection occurs in the nose, glabella or upper lip, it may cause death because of the direct venous communication between these areas and the lateral sinuses. When moles and warts are treated by lay operators there are additional dangers resulting from lack of diagnostic ability. As they are unable to differentiate between benign moles and those which are malignant or may become malignant neoplasms as the result of trauma during treatment, serious sequelae may follow. To avoid the hazards of infection and improper diagnosis the operator should have some understanding of anatomy, physiology, bacteriology, antisepsis and tissue tolerance to trauma, as well as the chemical reaction involved in electrolysis and the physics and mechanics of the apparatus used. Pitting and scars may result from the application of too much current or too long a treatment, as well as from improper insertion of the needle into the hair follicle. If the operator makes several stabs at a single follicle or treats too many hairs in a given

area, infection and scarring may be expected to ensue. Because of the serious consequences that may result when electrolytic machines are misused, the Council on Physical Therapy approved an article on the subject by Dr. Anthony C. Cipollaro, which appeared in a recent issue of the J. A. M. A. The article merits attention by every physician, since all of us are frequently asked for advice on this subject. — [J. A. M. A. **112**:242 (Jan. 21) 1939.]

Zur Frage der Wirbelsäulenveränderungen nach Tetanus. E. Feistmann-Lutterbeck.

Acta radiol. **19**:391 (Oct.) 1938.

Fourteen patients who had recovered from tetanus were subjected to clinical and roentgenologic control. In only one, a boy of 8 years who had survived severe tetanus 2½ years earlier, was it possible to demonstrate any change in the vertebral column which could be regarded as characteristically post-tetanic. It consisted of an isolated flattening of the 7th thoracic vertebra with slight participation of the adjacent intervertebral discs. Advancement of a spondyloarthrosis which had been present before the tetanus had to be assumed in another instance. All the other cases showed lesions not beyond the normal so that the frequency of the post-tetanic alterations amounted to only 7 per cent.

Some Cranial Changes in Recklinghausen's Neurofibromatosis. Thomas Rosendal.

Acta radiol. **19**:371 (Oct.) 1938.

The author describes the roentgenologically diagnosed cranial changes in 8 patients with clinical symptoms of Recklinghausen's neurofibromatosis. In 2 cases there was present dilatation of both optic foramina, with oligodendrocytoma of the optic chiasm, in 1 case there showed abnormal vascular design in the cranial wall and depression of the sella turcica with diagnosed arachnoiditis; in 3 cases one saw unilateral, secondary atrophic cranial changes, corresponding to facial hypertrophy of the same side; finally, in 2 similar cases, there was unilateral enlargement of the orbit, the middle cranial fossa (specially the anterior and medial walls), and the sella turcica.

The opinions expressed in the literature concerning the pathogenesis are reviewed, and on the basis of these the changes in the reported cases are discussed. In regard to two of them, the author believes that the development of neurofibromas in the orbit, with thinning and dislocation of the posterior wall of the latter, due to the weight of the brain, has a contributive factor.

Roentgen Diagnosis of Lung Embolism. Nils Westermark.

Acta radiol. **19**:357 (Oct.) 1938.

In embolism of the pulmonary artery a distinction can be made between emboli without and emboli with infarction. Each one of these forms presents its own typical roentgen appearance.

In embolism of the pulmonary artery without infarction we get ischaemia of the branches of the pulmonary artery on the peripheral side of the embolus. On the radiogram this ischaemia appears as a clarified area with diminished vascular design corresponding to the extent of the embolized artery. The vascularization is, however, maintained in the central parts of the lung. The vascularization takes, however, a rapid end to pass over the above mentioned area of non-vascularization.

The infarct appears on suitable projection as a wedge-shaped massive homogeneous shadow. In most cases, however, where infarction is present one is able to observe also within other parts of the lung larger or smaller wedge-shaped clarifications as in embolism without infarction.

Pityriasis Rosea. George H. Curtis.

Cleveland Clinic Quarterly **6**:29 (Jan.) 1939.

Because pityriasis rosea is a mild, acute exanthem of short duration with practically no complications, treatment is unnecessary in many cases. In those patients who have a mild infection of the upper respiratory tract or systemic reaction, symptomatic treatment may be instituted.

If pruritus is a pronounced feature, mild, sedatives may be given for a few days. Locally, a lotion consisting of phenol 1 to 2 per cent, resorcin 2 to 3 per cent, zinc carbonate 10 Gm., zinc oxide 10 Gm., olive oil 64 cc. and aqua calcis, q.s.a.d. 128 cc. amy be employed as an antipruritic and to remove the scales. The eruption appears to produce an increased irritability of most patients' skin such that stronger kerotolytics may cause a secondary dermatitis. It is for this reason that the skin of most patients is eczematized when strong keratolytic and fungicidal ointments and lotions are used.

When it is necessary to shorten the course of the disease for cosmetic reasons, Curtis employs ultraviolet irradiation which in most cases gives good results. The skin is irradiated for one minute at a distance of 30 inches the first dose. Thereafter the daily treatment is increased by one minute to 15 minutes, at which time the distance is shortened by one inch daily until the irradiation is 15 minutes at 18 inches distance. Usually the eruption will begin to disappear in about 2 weeks.

Low Intensity Short Wave Treatment. Jean Mayer.

Ann. de l'Institut d'Actinologie **12**:99 (June) 1938.

In the beginning short wave therapy was applied by us in rather heavy doses on the assumption that the therapeutic effect is proportionate to the amount of heat, but later we used weak doses on the assumption that there must exist a pure electromagnetic effect which is independent to the heat effects. In reality we have to apply variable dosage according to the peculiar case of each patient depending on the organ and the nature of the disease and the material applied. The sensibility of the various subjects is widely different. Some react

already to very mild dosage; others only to the very strong ones. The hypophysis and ovaries react to very mild doses. The lungs need greater irradiation. The inflammatory diseases and some sympathetic processes have the tendency to get worse if we increase the local temperature. Also in some other cases an increased heat, even if within certain limits, is most favorable. For the same amount of surface heating the dosage absorbed in the deep tissue is the greater the shorter the wavelengths or the bigger the air space between electrodes and the skin. For the same depth penetration the surface heating will depend on the material. In practical treatment we use in the beginning rather mild dosage increasing progressively depending on the reaction we get if this increased power absorption is not limited by the patient's tolerance.

Pulmonary Ventilation In Artificial Respiration. B. G. King, With Assistance of H. F. Standerwick; W. W. Schier, and J. F. Steinman.

J. Indus. Hygiene & Toxicology **20**:576 (Nov.) 1938.

King compared the pulmonary ventilation of twenty-one conscious male subjects during application of the Schafer, the Holger Nielsen and Drinker's "combined" methods of artificial respiration. The Drinker combined method gave the greatest respiratory exchange per respiration. It was administered at the rate of five a minute; it caused no discomfort when applied to a conscious subject. It is concluded that this method has definite value as an alternative method to the Schafer prone pressure technic. It has the advantage, as far as the subject is concerned, of adequate ventilation when applied at a slower rate. By increasing the rate a greatly augmented ventilation could be effected. When used with the inhalator this method would be of value in cases of carbon monoxide poisoning. — [Abst. J. A. M. A. **112**:272 (Jan. 21) 1939.]

The Action of Diathermy on the Glands of Internal Secretion. Cicera Terre.

Bull. off. de la Soc. franc. d'Electrotherapie et de Radiologie **47**:214 (Oct.) 1938.

Two cases are reported. In the first one the patient, 42 years old, with fibroma refused to be treated by x-rays. The treatment used was diathermy of the hypophysis or through the occiput (the same electrodes were used as in transcerebral ionization) with a current of 300 to 400 ma. in 20 minutes exposure, five treatments per week during one month. The hemorrhage and the pains disappeared, the tumor receded. The patient felt better and has maintained good health during the succeeding three years.

In the second case, the cryptorchide (simple or two-fold) in children is treated by a small electrode measuring 5x5 centimeters applied to the testicles with 400 to 500 ma. current in a treatment of 20 minutes exposure. After this treatment pneumatic massage was applied. After the treatment mentioned above the pains disappeared and the testicles gained a normal volume and the signs of infantilism disappeared.

On the Roentgen Diagnosis of Primary Tumors of the Lung. Nils Westermark.

Acta radiol. **19**:506 (Dec.) 1938.

In benign neoplasms of the lung a line of demarcation can be drawn between bronchial and pulmonary tumors. The former grow within the bronchi. From a patho-anatomical viewpoint the following kinds are recognized: polypus, fibroma, lipoma and adenoma. These tumors give rise to bronchostenosis which eventually dominates the roentgen picture. Bronchography is necessary for diagnosing the condition. The pulmonary tumors grow expansively into the lung and are often congential. They extend to the periphery of the lung. Chondromata are the commonest. These appear as rounded or somewhat irregular shadows in the lung, generally with calcifications in the tumor. Other mesenchymal tumors also occur. In order to distinguish these from extra-pulmonary growths bronchography should be carried out and diagnostic pneumothorax induced.

Among malignant tumors a distinction is made between cancer bronchiale and sarcoma pulmonum. The former condition in most cases gives rise to bronchostenosis. This is generally in evidence on the radiogram earlier than the tumor shadows. For the sake of making an early diagnosis one should thus consider the changes brought about by the bronchostenosis and carry out bronchography. In early stages the cancer is generally localized to finer bronchial branches. From here it then progresses in a central as well as peripheral direction. At the final stage either extensive infiltration of an entire lung-lobe or metastases in the hilum dominate the picture.

In rare cases, and then generally a more benign form of cancer, the tumor takes on an expansive form of growth and forms well defined rounded tumor shadows around air-filled bronchi. Sarcoma pulmonum is a relatively rare condition. Such tumors grow expansively in the lung and form larger or smaller rounded homogeneous tumor shadows.

On Bronchostenosis, a Roentgenological Study. Nils Westermark.

Acta radiol. **19**:313 (Oct.) 1938.

Bronchostenosis is a very common phenomenon in different kinds of pulmonary disease. From a radiological point of view it can be divided into 3 stages: Stage 1 shows mild atelectasis and hyperaemia, stage 2 shows local emphysema and anaemia, and stage 3 shows massive pulmonary collapse (obstructive atelectasis). The alterations are located in the lung area corresponding to the constricted bronchus. Between the first and second stage there is a transitory stage with inspiratory atelectasis and expiratory emphysema. The anatomic distribution of the bronchi causes the changes in suitable projections to appear as wedge-shaped. With the changes present in stages 1 and 3 the pulmonary region corresponding to the constricted bronchus occupies a smaller volume than normal. The wedge-shaped shadows

then often assume a concave outline. With the changes present in stage *2*, the lung region corresponding to the constricted bronchus occupies a larger volume than normal. The wedge-shaped cleared-up areas then attain a convex outline. In advanced forms the changes assume a spherical shape. Since the reduction in volume in stages 1 and 3 is more marked during inspiration than in expiration and the increase in volume in stage *2* is greater in expiration than inspiration respiratory oscillation of heart and mediastinum will take place in all the stages.

A bronchostenosis may arise from changes in the lumen, changes in the bronchial wall and changes outside the lumen. The author gives an account of the occurrence and course of bronchostenosis in different kinds of lung disease and discusses the importance for a correct interpretation of the radiogram and the complications that may be produced.

Regional Gastrospasm Disease of the Pancreas. Max Lüdin. (Regionärer Gastrospasmus bei Pankreaserkrankung.) Max Lüdin.

Acta radiol. **19**:348 (Oct.) 1938.

The author reports a case of chronic lesion in the head of the pancreas with pancreatic concrements and also a case of acute pancreatitis. In both cases the roentgen examination made possible a diagnosis of regional gastrospasm of the praepyloric portion.

Roentgenologic Differentation Between Pleuritis and Empyema Based on Some Important Clinical Facts. (Zur Röntgenologischen Differentialdiagnose zwischen Pleuritis und Empyem nebst einigen wichtigen klinischen Daten.) Sten Oldberg.

Acta radiol. **19**:337 (Oct.) 1938.

The author discusses first the factors which normally influence the position of the diaphragm and then passes on to the roentgen picture of pleural exudate. A sufficiently large quantity of serous exudate flattens and depresses the cupola of the diaphragm and increases the respiratory movement of the mediastinum. In basal septic empyema on the other hand, the diaphragm is usually held up high against the chest wall. This is due chiefly to a paresis of the diaphragm which also considerably reduces the movement of the mediastinum. Serous exudate usually shows a concave border towards the lung while empyema becomes encapsulated and presents a bulging contour toward the pulmonary parenchymae. The author points out the importance of high paracentesis when empyema is suspected and gives an account of three illustrative cases.

Direct or Alternating Current Arc Lamps for Light Therapy? Axel Saugman.

Acta Radiologica. **20**:75 (Feb.) 1939.

The merit of direct and alternating current arc lamps for light therapy is discussed. The author concludes, that the small advantages, offered by the direct current lamps, does not justify the much greater expense involved.

Results After Use of Filtered Ultraviolet Light During Laparotomies. T. Mart.

Bruns'Beitr. z. klin. Chir. **169**:84 (Jan. 31) 1939.

Mart reviews the clinical possibilities of filtered ultraviolet irradiation in relation to the after care of certain surgical operations. The author observed its clinical benefits when he applied a modified Havlicek technic of filtered light in cases of laparotomies, and accordingly he feels that this form of light irradiations form a valuable adjuvant to routine surgical procedure. The results obtained signify that there is a reduction of post-operative pain, and that the incidence of post-surgical thrombosis and embolism is lessened. Mart particularly emphasizes its value in controlling the vitality of strangulated gut, and feels that the reaction is especially marked in many cases of suppurative peritonitis, whose recovery is largely due to the benefits obtained from the stimulating and bactericidal factors inherent in this special form of filtered ultraviolet light.

A New Technic and Dosage System for Gamma Ray Therapy in Surface Application of Radium. Magnus Strandqvist.

Acta radiol. **20**:1 (Feb.) 1939.

A correlation of standardized arrangements of radium in applicators of glass capsules of constant size with a special dosage calculation constitutes what is here called a new technic and dosage system for x-ray therapy in surface application of radium. The size of the area to be treated decides the size of the applicator and thus the number of the glass capsules; as a result the number of radium tubes and their arrangement are fixed. Thus each applicator gives radiation of known physical intensity. The average of the intensity at the surface and at each successive point to a depth of 1 cm. has been determined according to a derived formula. If the same "average dose," calculated from this "average intensity," is given with each applicator, the biologic effect is found to be the same. It is interesting to find that these "average doses" of radiation are of approximately the same values as the "average doses" ordinarily used in roentgen therapy.